



ROHDE & SCHWARZ

Manual

ARTIFICIAL MAINS NETWORK

ESH2-Z5 SH2-Z5

338.5219.53 338.53

Use and Operating Instructions

and Remote Control

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ACCESSORIES

for the TEST RECEIVER

ESH 2

and the programmable

TEST RECEIVER

ESH 3

ESH 2: Data sheet 303 202

ESH 3: Data sheet 335 801

HFH 2: Data sheet 335 301

Table of accessories

Designation	Order number	For use with	Electric field-strength measurement				
			Magnetic		Radio interference measurement		Current measurement
		ESH 2 ESH 3					High-impedance voltage measurement
Rod Antenna	HFH 2-Z1	335.3215.52	●	●	●	●	
Loop Antenna	HFH 2-Z2	335.4711.52	●	●	●	●	
Loop Antenna	HFH 2-Z3	335.6214.52	●	●	●	●	
Inductive Probe	HFH 2-Z4	338.3016.52	●	●	●	●	
Roof-mounting Kit	HFH 2-Z5	335.5718.02	●	●	●	●	
Tripod	HFU-Z	100.1114.02	●	●	●	●	
Clamp-on RF							
Current Probe	ESH 2-Z1	338.3516.52	●	●	●	●	
Active Probe	ESH 2-Z2	299.7210.52	●	●	●	●	●
Passive Probe	ESH 2-Z3	299.7810.52	●	●	●	●	●
Attenuator	ESH 2Z31	827.6513.02	●	●	●	●	●
24-V Adapter	ESH 2-Z4	338.4512.02	●				
Artificial Mains							
Network	ESH 2-Z5	338.5219.53	●	●	●		
19" Adapter	ESH 2-Z6	338.4312.02	●				
Service Kit	ESH 2-Z7	338.4112.00	●	●			
Attenuator	ESH 2Z11	349.7518.52	●	●	●	●	
Connecting Cable	ESH 3-Z1	349.6011.02		●			
Pulse Limiter	ESH 3-Z2	357.8810.52	●	●	●	●	●
Preamplifier	ESH 3-Z3	827.8016.52	●	●	●	●	●
Recorder Adapter	ESV-Z4	800.8015.02	●	●	●	●	●

Data sheet

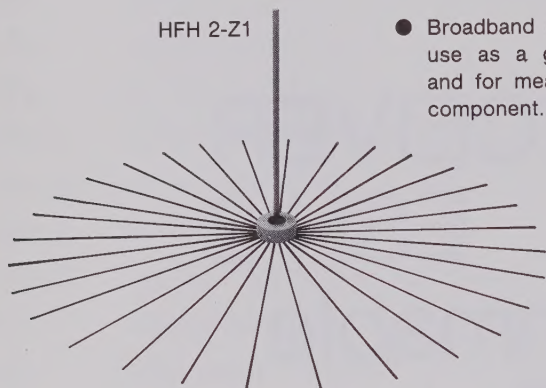
303 203

E - 3

FIELD-STRENGTH MEASUREMENTS

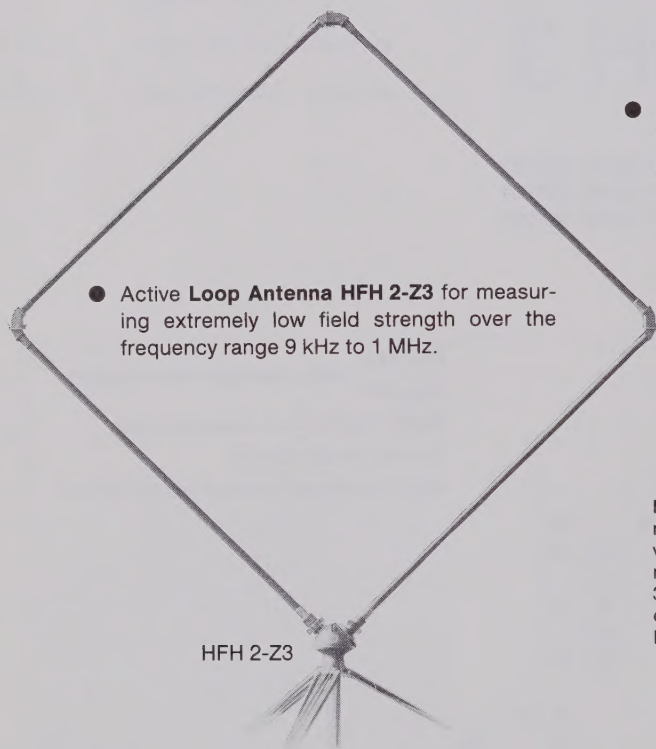
Rod Antenna HFH 2-Z1, Loop Antennas HFH 2-Z2 and HFH 2-Z3, Inductive Probe HFH 2-Z4

The recommended extras available for the ESH 2 and ESH 3 include four antennas:



HFH 2-Z1

- Broadband active **Rod Antenna HFH 2-Z1** for use as a general-purpose receiving antenna and for measuring the electrical field-strength component.



HFH 2-Z3

- Active **Loop Antenna HFH 2-Z3** for measuring extremely low field strength over the frequency range 9 kHz to 1 MHz.

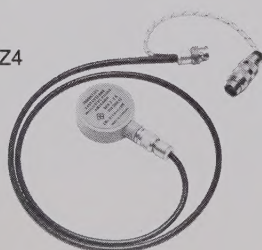


HFH 2-Z2

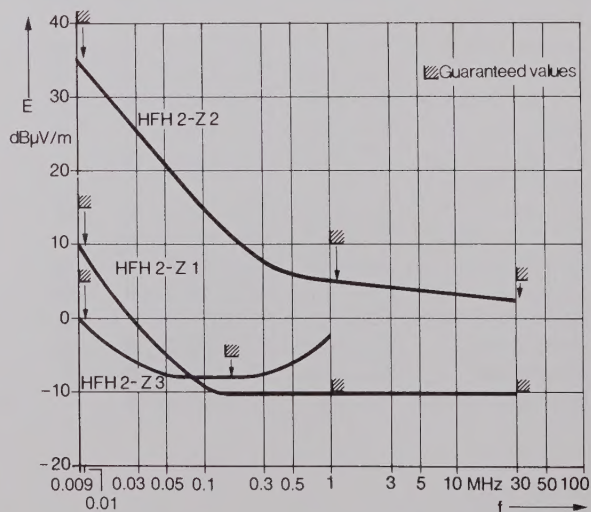
- Active **Loop Antenna HFH 2-Z2** for measuring the magnetic field-strength component.

- **Inductive Probe HFH 2-Z4** for simple approximate measurements of the magnetic field-strength component.

HFH 2-Z4



Minimum measurable field-strength level (for $S/N = 1$) of the antennas HFH 2-Z1, -Z2 and -Z3 as a function of the frequency (average-value indication and 200 Hz IF bandwidth). In the CISPR indicating modes the minimum measurable field strength increases by about 3 dB over the range 9 kHz to 149.9 kHz (CISPR 3) and about 23 dB over the range 150 kHz to 30 MHz (CISPR 1). Dashed line below HFH 2-Z1 characteristic: conversion factor k set to 10 dB



FIELD-STRENGTH MEASUREMENTS

Specifications

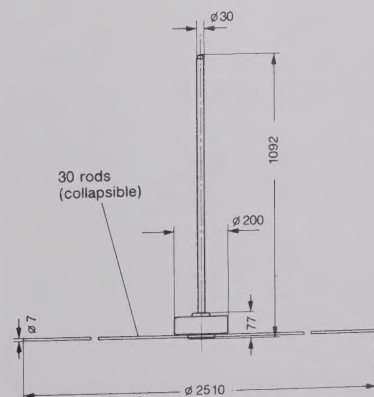
	Rod Antenna HFH 2-Z1	Loop Antenna HFH 2-Z2	Loop Antenna HFH 2-Z3	Inductive Probe HFH 2-Z4
Frequency range	9 kHz to 30 MHz	9 kHz to 30 MHz	9 kHz to 1 MHz	100 kHz to 30 MHz
Conversion factor k ¹⁾ (E → V) Error	20 dB, referred to 1/m ² < 1 dB	20 dB, referred to 1/m < 1 dB	10 dB, referred to 1/m < 1 dB	80 dB, referred to 1/m < 6 dB
Measurement range (IF bandwidth 200 Hz, average-value indication) Lower limit (frequency-dependent, see diagram on page 2)	+15 to -10 dBμV/m	9 kHz to 1 MHz: +40 to +10 dBμV/m; 1 MHz to 30 MHz: +10 to +5 dBμV/m 140 dBμV/m	+5 to -5 dBμV/m	50 dBμV/m (approx. 0 dBμA/m)
Upper limit (1-dB compression)	140 dBμV/m	140 dBμV/m	140 dBμV/m	> 190 dBμV/m (approx. 140 dBμA/m)
Source impedance	50 Ω	50 Ω	50 Ω	50 Ω
Max. output voltage into 50 Ω	1 V	1 V	3 V	—
General data				
Rated temperature range	-10 to +55 °C	-10 to +55 °C	-10 to +55 °C	-10 to +55 °C
Storage temperature range	-25 to +70 °C	-25 to +70 °C	-25 to +70 °C	-25 to +70 °C
Inputs				
RF	BNC female	BNC female	BNC female	BNC male
Supply and coding (antenna factor)	12-contact Tuchel female connector	12-contact Tuchel female connector	12-contact Tuchel female connector	12-contact Tuchel male connector
Length of connecting cable	10 m	10 m	10 m	1 m
Current drain (±10 V, varies with output level)	< 40 mA	< 40 mA	< 50 mA	—
Dimensions (diameter/height)	See illustration	See illustration	See illustration	50 mm/20 mm
Weight	In transport case, without cable: 8 kg	In transport case, without cable: 12 kg	Without cable, with (without) transport case: 43 (17) kg	With cable: 0.3 kg
Order designation	► Rod Antenna HFH 2-Z1 335.3215.52	► Loop Antenna HFH 2-Z2 335.4711.52	► Loop Antenna HFH 2-Z3 335.6214.52	► Inductive Probe HFH 2-Z4 338.3016.52
Accessories supplied	Coaxial cable (10 m): 335.3609.00; Supply/coding cable (10 m): 335.3596.00; 12-contact Tuchel female connector: 018.5079.00; manual	Same as HFH 2-Z1	Same as HFH 2-Z1	Manual
Recommended extras	—	Tripod HFU-Z (in transport bag): 100.1114.02	Same as HFH 2-Z2	—

¹⁾ Conversion factor = logarithm of the ratio between the output voltage and the input field strength; automatically taken into account in the readouts of the ESH 2 and ESH 3.

²⁾ k = 10 dB selectable by internal link; the upper test limit is then at 130 dBμV/m.

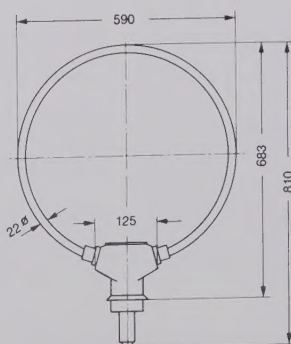
Dimensions of antennas (in mm)

HFH 2-Z1

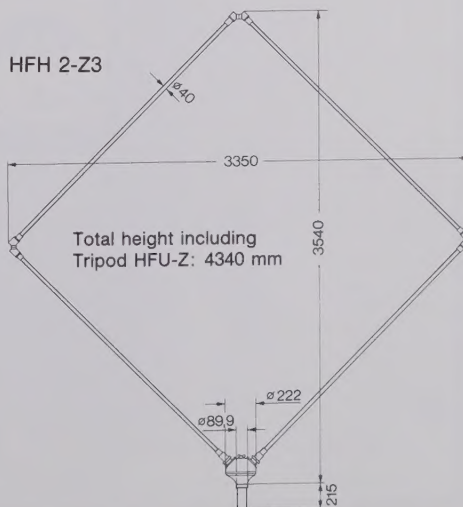


HFH 2-Z2

Total height including Tripod HFU-Z:
1480 to 2180 mm



HFH 2-Z3



INTERFERING VOLTAGE MEASUREMENT

Artificial Mains Network ESH 2-Z5

For interfering voltage measurements on AC-supply-dependent loads, a circuit must be provided to ensure that the AC supply voltage is supplied to the test item, on the one hand, and, on the other hand, that the AC supply represents a defined load impedance for the test item, that interference from the AC supply does not reach the test circuit, and that the defined interfering voltage produced by the test item can be applied to a test receiver suitable for radio interference measurements, such as the ESH 2 or ESH 3.

The **Artificial Mains Network ESH 2-Z5** (LISN) as a V network ($50 \mu\text{H} + 5 \Omega$) shunted by 50Ω meets the requirements laid down in VDE 0876 and CISPR 3. It uses air-cored coils and contains an artificial hand as well as a switchable artificial ground conductor. A built-in blower with a separate AC supply provides automatically controlled cooling or continuous cooling, as required.

The ESH 2-Z5 can be adapted by the user to other connector systems for the connection of the test item.

The connection of the Pulse Limiter ESH 3-Z2 to the receiver input is recommended.

For phase switchover in an automatic test system, the Artificial Mains Network can also be remotely controlled via TTL control inputs using the R&S Controllers PUC, PCA 5 and EZM.

Specifications

Frequency range	9 kHz to 30 MHz
Equivalent circuit (to VDE 0876)	($50 \mu\text{H} + 5 \Omega$) shunted by 50Ω
Error limits (to VDE 0876)	$\pm 20\%$
Continuous-rated output current	$4 \times 25 \text{ A}$
Max. instantaneous output current	$4 \times 50 \text{ A}$
Max. AC supply frequency	63 Hz
Max. AC supply voltage to reference ground	250 V
Cooling	built-in blower

Connectors

AC supply inputs	
$4 \times 32 \text{ A}$	Cekon male
Blower connector	male European standard
AC supply outputs for test item	
$2 \times 16 \text{ A}$	female with earthing contact
$4 \times 32 \text{ A}$	Cekon female
RF output	BNC female
Remote control input	50-contact Amphenol female
Artificial hand	telephone jacks

General data

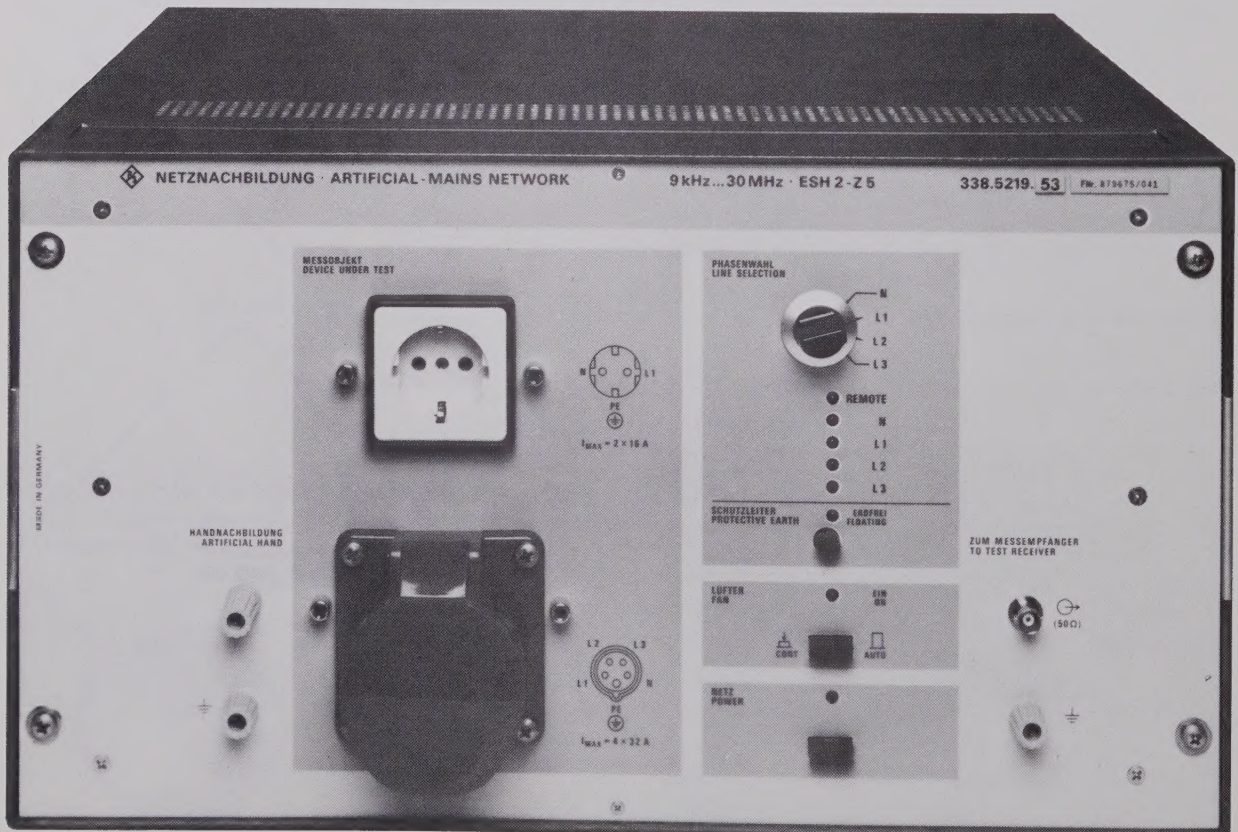
Rated temperature range	-10 to $+45^\circ\text{C}$
Storage temperature range	-25 to $+70^\circ\text{C}$
AC supply (blower)	100/120/220/240 V (20 VA), 47 to 63 Hz
Overall dimensions (W x H x D)	492 mm x 294 mm x 603 mm
Weight	26 kg
Colour	front panel: light grey cabinet: bluish grey
Engravings	German + English

Order designation	► Artificial Mains Network ESH 2-Z5 338.5219.53
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Accessories supplied

Power cord	025.2365.00 (for operation of blower)
RF connecting cable	100.6945.20
Amphenol male connector (50-contact)	018.5904.00
Cekon AC female adapter (5-contact)	441.4610.00
Cekon male connector (5-contact)	448.0640.00
Earthing-contact male connector	018.3299.00
Manual	

ESH 2-Z5

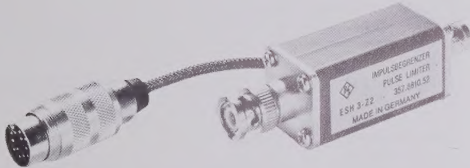


INTERFERING VOLTAGE MEASUREMENT

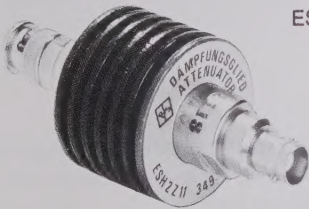
Pulse Limiter ESH 3-Z2 Attenuator ESH 2Z11

High RF input levels as well as high-energy interfering pulses that may result from switching on or off the test item connected to an artificial mains network may cause damage to the RF input circuits of test receivers. The Pulse Limiter **ESH 3-Z2** and the Attenuator **ESH 2Z11** limit and reduce the interference level. The pulse limiter is fitted with a coding plug for the Test Receivers ESH 2 and ESH 3 which then automatically take into account the insertion loss.

ESH 3-Z2



ESH 2Z11



Specifications

Pulse Limiter ESH 3-Z2

Frequency range	0 to 30 MHz
Insertion loss	10 ± 0.3 dB
Frequency response (0 to 30 MHz)	≤ 0.2 dB
VSWR with 50-Ω termination	
Input	≤ 1.06
Output	≤ 1.25
Power-handling capacity in continuous operation	1 W
Pulse power-handling capacity	see diagram

General data

Rated temperature range	-10 to +45 °C
Storage temperature range	-25 to +70 °C
Connectors	
RF	BNC (female/male)
Coding (insertion loss)	12-contact Tuchel
Dimensions (L × W × H)	94 mm × 25 mm × 25 mm
Weight	0.12 kg

Order designation ▶ Pulse Limiter ESH 3-Z2
357.8810.52

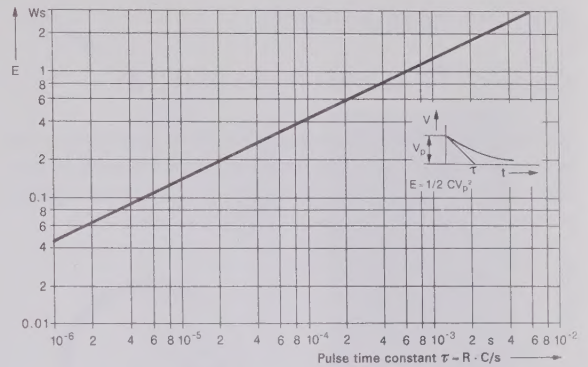
Attenuator ESH 2Z11

Frequency range	0 to 1500 MHz
Insertion loss	
f ≤ 500 MHz	20 ± 0.25 dB
f ≤ 1000 MHz	20 ± 0.5 dB
f ≤ 1500 MHz	20 ± 1.5 dB
Characteristic impedance	50 Ω
Power-handling capacity in continuous operation	10 W
Pulse power-handling capacity	750 W (3 μs)

General data

Rated temperature range	-55 to +125 °C
Connectors	BNC (female/male)
Dimensions (length/diameter)	97 mm/42 mm
Weight	0.15 kg

Order designation ▶ Attenuator ESH 2Z11
349.7518.52



Pulse power-handling capacity of Pulse Limiter ESH 3-Z2
(pulse energy $E = f(\tau)$)

Voltage and current measurement

Preamplifier ESH 3-Z3

With the aid of the Preamplifier ESH 3-Z3, the noise figure of the Test Receivers ESH 2 and ESH 3 is reduced by about 7 dB, so that the average value of noise at 200-Hz IF bandwidth is typically -37 dBμV. The Preamplifier is fed via the ESH 2/3/supply and coding socket which is also used for level display correction. The ESH 3-Z3 is also fitted with a gated coding input to ensure that with a current probe or passive probe connected, the level and unit display of the test receiver fitted with a preamplifier will be corrected.



Specifications

Frequency range	9 kHz to 30 MHz
Gain	10 dB
Frequency response flatness	max. ±1 dB, referred to 1 MHz, typ. ≤ ±0.5 dB

Input and output impedance	50 Ω
Input VSWR	
with ESH 2/ESH 3 at	
RF attenuation of 0 dB	< 2, typ. 1.25
Noise figure	< 6 dB, typ. 5 dB
1-dB compression point (output level)	+13 dBm (typ.)
d ₃ intercept point (IP ₃) (output level)	+27 dBm (typ.)

Connectors	
RF input and output	2 × BNC female
Coding for ESH 2/3	12-contact Tuchel male
Coding	12-contact Tuchel female

General data

Rated temperature range	-10 to +50 °C
Storage temperature range	-25 to +70 °C
Dimensions (W × H × D)	160 mm × 29 mm × 110 mm
Weight	0.4 kg

Order designation ▶ Preamplifier ESH 3-Z3
827.8016.52

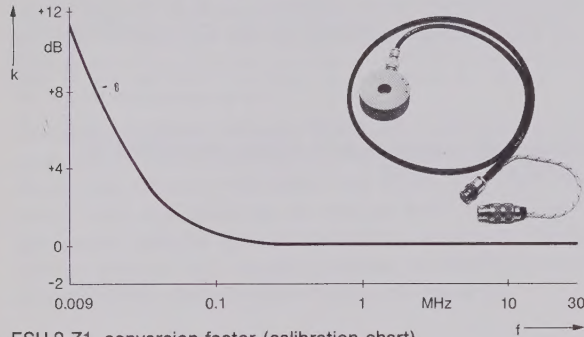
Accessories supplied BNC-BNC connecting cable
(30 cm)

CURRENT, VOLTAGE MEASUREMENTS

Current measurements

Clamp-on RF Current Probe ESH 2-Z1

Selective or broadband measurements of both very small and very large RF currents on conductors are easy to perform with the aid of the ESH 2-Z1. It is shielded against electrostatic effects and built to VDE standard 0876.



ESH 2-Z1, conversion factor (calibration chart)

Specifications

Frequency range ¹⁾	9 kHz to 30 MHz
Measurement range using ESH 2/ESH 3 (IF bandwidth 200 Hz, average-value indication)	
Lower limit (frequency-dependent)	approx. -30 dBμA
Upper limit	137 dBμA
Transfer admittance	1 S
Conversion factor ¹⁾ (I → V)	0 dB referred to 1 S
Error of conversion factor	< 1 dB
Max. permissible current with	
f > 10 kHz	10 A
f < 500 Hz	50 A
Max. diameter of conductor under test	13.5 mm

General data

Rated temperature range	-10 to +55 °C
Storage temperature range	-25 to +70 °C
RF connector	BNC male
Termination	50 Ω
Length of connecting cable	1 m
Coding plug (conversion factor)	12-contact Tuchel
Dimensions (diameter/height)	55 mm/20 mm
Weight	0.4 kg

Order designation ▶ Clamp-on RF Current Probe
ESH 2-Z1
338.3516.52

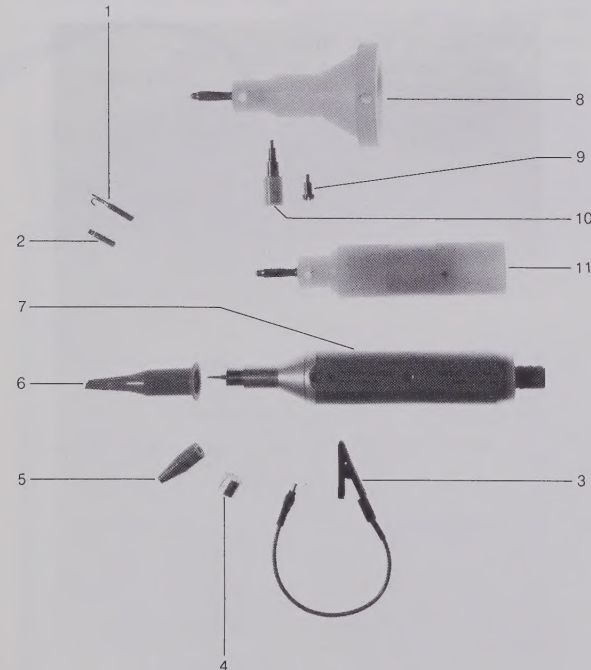
Accessories supplied: Manual

¹⁾ The conversion factor is automatically taken into account as from 0.1 MHz in the readout of the ESH 2 and ESH 3. The Clamp-on RF Current Probe ESH 2-Z1 can also be used at frequencies below 0.1 MHz. The conversion factor (= logarithm of the ratio between output voltage and input current) rises to 11.5 dB at 9 kHz (calibration chart supplied as an accessory).

High-impedance measurements

Active Probe ESH 2-Z2 and Passive Probe ESH 2-Z3

For high-impedance measurements of wanted and interfering signals on lines, shielded probes are used. They contain highpass filter sections to reject LF AC voltages.



Passive Probe ESH 2-Z3 (7), hook tip (1), solder tip (2), ground lead (3), ground sleeve (4), probe tip (5), spring hook adapter (6), corresponding to accessories for Active Probe ESH 2-Z2. Additional accessories for ESH 2-Z3: high-tension tip (8) and ground socket (10) with ground screw (9). Attenuator ESH 2Z31 (11) is a recommended extra

The **Active Probe ESH 2-Z2** is designed for measuring AC voltages over the frequency range 9 kHz to 30 MHz on lines that do **not** carry AC supply voltage.

The **Passive Probe ESH 2-Z3** (to VDE 0876 standards) is particularly suitable for measuring radio interference voltages on, for example, AC-supply lines.

The Attenuator ESH 2Z31 is provided for determining the noise source impedance in accordance with VDE 0877, Part 1/11.81 when measuring radio interference voltages with the ESH 2-Z3.

Specifications

	ESH 2-Z2	ESH 2-Z3
Frequency range	9 kHz to 30 MHz	9 kHz to 30 MHz
Attenuation ¹⁾	10 dB	30 dB
Deviation of attenuation from nominal value (Z _{source} = 50 Ω)	< 1 dB	< -1 to +4 dB
Measurement range using ESH 2/ESH 3 (Lower limit (frequency-dependent), IF bandwidth 200 Hz)		
Average-value indication	approx. -20 dBμV	approx. 0 dBμV
Upper limit	120 dBμV	150 dBμV
Input impedance	118 kΩ ± 5% shunted by 8 pF	1500 Ω ± 2% shunted by 9 pF (with 50-Ω termination)
Max. input voltage (V _{rms})		
f ≤ 63 Hz	100 V	250 V
f < 500 Hz	5 V	250 V
f = 9 kHz to 30 MHz	3 V	30 V
General data		
Rated temperature range	-10 to +45 °C	-10 to +45 °C
Storage temperature range	-25 to +70 °C	-25 to +70 °C
Supply voltage	±10 V ± 1 V	—
Current drain	≈ ±15 mA	—
Length of connecting cable	1.5 m	1.5 m
RF connector	BNC male	BNC male
Termination	50 Ω	50 Ω
Supply and coding plug (attenuation)	12-contact Tuchel	12-contact Tuchel
Weight	0.2 kg	0.2 kg

Order designation ▶ Active Probe ESH 2-Z2 299.7210.52 ▶ Passive Probe ESH 2-Z3 299.7810.52

Accessories supplied
Accessory kit 241.0613.02
Probe tip 241.0913.02
Manual

Recommended extras

BNC Adapter URV-Z 241.1110.02
Attenuator ESH 2Z31 — 827.6513.02

¹⁾ Autom. taken into account in the readouts of the ESH 2 and ESH 3.

24-V Adapter ESH 2-Z4

The ESH 2 can be powered from a 24-V DC supply via the **24-V Adapter ESH 2-Z4** which may be mounted at the rear of the ESH 2 in the place of the power supply or battery pack.

Specifications

Input voltage range
(protected against reversal
of polarity) +18 to +32 V
Input connector
(mating connector
is supplied with the ESH 2-Z4) ... 6-contact male standard

Output voltage range +12.5 V $\pm$ 0.5 V
Output connector 4-contact female special
Maximum output current
(short-circuit-proof) 2 A

Rated temperature range -10 to +45 °C
Storage temperature range -25 to +70 °C
Dimensions (W x H x D) 205 mm x 172 mm x 50 mm
Weight 1 kg

Order designation ► 24-V Adapter ESH 2-Z4
338.4512.02

Accessories supplied
Mating connector, female 018.6946.00
Manual

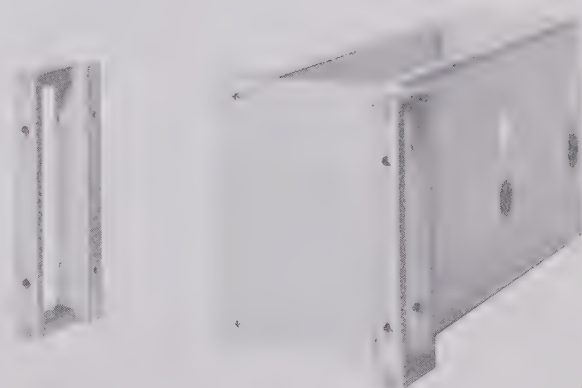


ESH 2-Z4

19" Adapter ESH 2-Z6

permits the bench model of the ESH 2 to be converted to a 19" rackmount, four dimensional units in height.

Order designation ► 19" Adapter ESH 2-Z6
338.4312.02

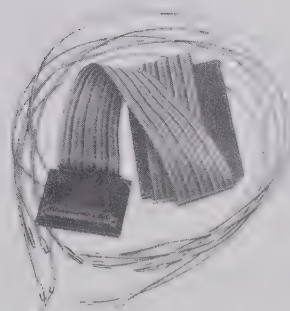


ESH 2-Z6

Service Kit ESH 2-Z7

permits plug-in circuit boards of Test Receivers ESH 2 and ESH 3 to be operated outside the instrument when carrying out repair work. It comprises a 48-core flexible adapter cable and 14 coaxial connecting cables.

Order designation ► Service Kit ESH 2-Z7
338.4112.00



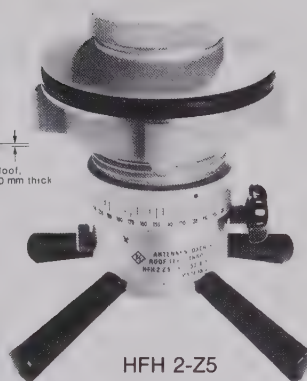
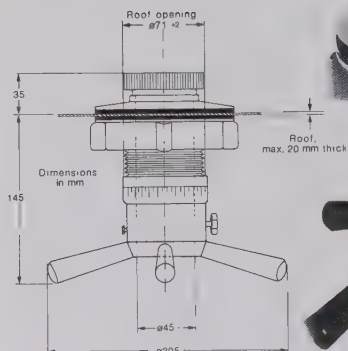
ESH 2-Z7

EXTRA ACCESSORIES

(continued)

Roof-mounting Kit HFH 2-Z5

The Roof-mounting Kit is used for fixing the Loop Antenna HFH 2-Z2 on the roof of a vehicle, where it is permanently mounted. The antenna can be rotated from inside the vehicle. A scale in degree divisions permits reproducible settings. The opening in the vehicle roof must have a diameter of 72 mm, the maximum roof thickness is 20 mm. Rubber rings are used for sealing. The loop antenna is inserted from above. The RF and coding sockets are accessible from inside the vehicle. When the loop antenna is dismounted, the roof opening can be covered up by a hood.



HFH 2-Z5

Specifications

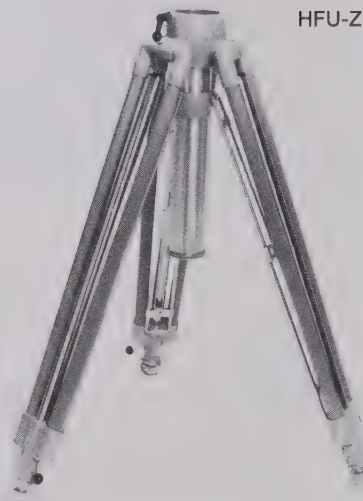
Dimensions see illustration
Weight 2.2 kg

Order designation ▶ Roof-mounting Kit HFH 2-Z5
335.5718.02

Tripod HFU-Z

is used for supporting the Loop Antennas HFH 2-Z2 and -Z3.

Order designation ▶ Tripod HFU-Z
110.1114.02



HFU-Z

Connecting Cable ESH 3-Z1

This cable is used for connecting the ESH 3 recorder output to the XYT Recorder ZSKT.

Order designation ▶ Connecting Cable ESH 3-Z1
349.6011.02



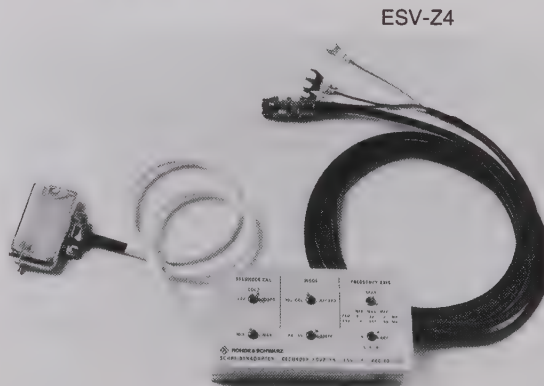
ESH 3-Z1

Recorder Adapter ESV-Z4

The Recorder Adapter ESV-Z4 is used as an interface between the test receiver (ESH 2 or ESV with X output) and the XYT Recorder ZSKT for calibration of the writing area and selection of the frequency span and X scaling (lin or log) in spectrum recording.

Dimensions
(case, W x H x D) 138 mm x 35 mm x 72 mm
Length incl. connecting cables 2200 mm

Order designation ▶ Recorder Adapter ESV-Z4
800.8015.02



ESV-Z4



ROHDE & SCHWARZ

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Printed in the Fed. Rep. of Germany · Subject to change · Data without tolerances: order of magnitude only

2.1 Legend for Front- and Rear-panel Controls

See Figs 13 and 14.

Item	Engravings	Function
<u>1</u>	ARTIFICIAL HAND	Terminal for circuit simulating effects of hand.
<u>2</u>	DEVICE UNDER TEST	Earthed socket for connecting a single-phase test item. Max. current 2 x 16 A
<u>3</u>	LINE SELECTION	Phase selector for manual control. The noise voltage on the selected line (N, L1, L2, L3) is taken to the RF output <u>7</u> . This selector is fully operative even if the AC supply is not connected to <u>16</u> .
<u>4</u>	REMOTE	LED display. The REMOTE LED lights up to show remote control via socket <u>12</u> . The LED indicating the selected line lights up at the same time. None of the LEDs lights up during manual phase selection.
<u>5</u>	PROTECTIVE EARTH	The non-fused earth conductor PE can be floating or taken to earth. The LED lights up when the conductor is in the floating condition. The AC supply must be connected to <u>16</u> in both manual and remote control.
<u>6</u>	FAN	The LED indicates that the fan is running. The key permits the fan to be switched for continuous operation (CONT) or only for automatic operation (AUTO) in case of overtemperature.
<u>7</u>	TO TEST RECEIVER	RF output to test receiver (50 Ω , BNC socket).
<u>8</u>		Earth terminal
<u>9</u>	POWER	Power switch and corresponding LED.
<u>10</u>	DEVICE UNDER TEST	CEKON socket for connecting a test item requiring three-phase supply (3 phases, neutral conductor, earth conductor). Maximum current 4 x 32 A.

Item	Engravings	Function
<u>11</u>		Earth sockets provided for maintenance (RF impedance measurements).
<u>12</u>	REMOTE CONTROL	50-way Amphenol socket for remote control of phase selection. Pin allocation as shown in section 2.2.6.
<u>13</u>		Fan: blowing into the unit
<u>14</u>		M5 threaded inserts for large-area connection of signal ground (see 2.2.2).
<u>15</u>		CEKON connector: AC supply for L1, L2, L3, N and PE.
<u>16</u>	100/120 V TO.5B 220/240 V TO.25B 47 - 63 Hz	AC supply for fan and remote control of phase selection.
<u>17</u>		Earth terminal

CAUTION

Prior to putting it into operation, the Artificial Mains Network must be earthed in compliance with VDE 0100 in order to avoid dangerous high voltages on the case.

This means that the earth terminal of the Cekon-type cable socket connected to 15 must be joined to the earth line of the AC supply using a lead with sufficiently large cross-section. For reasons of safety, we recommend that the case should also be earthed via the threaded inserts 14.

The leakage currents between the phases and the earth line exceed the permissible limits specified in VDE 0411. For this reason, the input to the Artificial Mains Network cannot be fed via a fault-current guard circuit.

2.2.1 AC Supply Connection

The Cekon connector 15 of the Artificial Mains Network is connected to the AC supply via a standard Cekon cable coupling (220/380 V, 32 A, 3P+N+PE, position of earth terminal: next to locating lug), i.e. via the 5-way Cekon-type cable socket, Order No. 441.4610.00, supplied with the network.

Pin allocation as shown in Fig. 1:

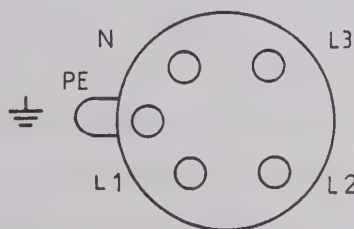


Fig. 1 Contacts of cable coupling seen from the terminal side of the socket or from the pin side of the chassis-mounted male connector 15.

Connection to the earth line is essential for reasons of safety (see also section 2.2).

The the test item is connected only to the single-phase socket 2 on the front panel, it is sufficient to connect neutral, L1 and the earth line PE.

Plug 16 is only used for the supply of the fan and the relay making the earth line PE floating, as well as in remote control. The fan supply is factory-adjusted to 220 V. If another supply voltage is required, remove the power cable, lift out the fuse holder with a screwdriver, insert the correct fuse (see engravings) and replace the fuse holder observing the marker arrows. When switch 6 is in position AUTO, the fan is switched on automatically if overheating occurs. When measuring devices of high power consumption, plug 16 should always be connected to the AC supply. See section 2.5 for max. load capacity of ESH2-Z5 with fan.

Inherent noise of built-in AC supply section: Since the noise voltage at power connector 16 is below the noise level of the test receiver, it has no effect on noise voltage measurements with the Artificial Mains Network ESH2-Z5.

2.2.2 Earth Connection

The Artificial Mains Network is connected to the earth line PE via power plug 15; but this connection is not suitable as a signal ground. In order to prevent interfering signals on the earth line of the AC supply being coupled to the signal ground, both are RF-isolated by a choke in the earth line. The choke must not be bypassed by the test receiver, which is also connected to the signal ground. Therefore either an isolated receiver must be used (e.g. ESH 2) or a choke must also be fitted into the earth line of the receiver (e.g. B82 302-A-5 from Siemens or FR 501 made by Schaffner).

The signal ground must be chosen with view to RF requirements, i.e. suitable are metal objects which are solidly grounded, such as water pipes or lightning protectors. (Connecting the signal ground or the earth line to water pipes is in the Federal Republic of Germany subject to a special permission (VDE 0190). No information can be given on comparable regulations in other countries.) The wall of a shielded room may also be used as earth. Effects on the signal ground by an unearthed test receiver in the RF cabine can be avoided by directly connecting the receiver cabinet to the shielded wall.

A metal strip fixed to the threaded inserts 14 is the contact to the signal ground. The left-hand side panel carrying the threaded inserts 14 is not anodized, in order to reduce the contact resistance.

2.2.3 Connecting the Test Receiver

The interference-measuring test receiver is connected to BNC socket 7 via a coaxial cable. An additional earth line for the test receiver can be fitted to terminal 8.

2.2.4 Connecting the Test Item

The test item can either be connected to the three-phase Cekon socket 10 or to the earthed single-phase socket 2. The single-phase socket has only three lines, neutral, phase L1 and earth PE.

According to VDE 0877, part 1/11.81, section 9.2.4.1, the earth line may be isolated from RF using switch 5. The test item is then earthed via a 1.6-mH choke in the earth line.

A 5-way Cekon-type plug (Order No. 448.0640.00) and a 3-way earthed socket (Order No. 018.3299.00) are part of the equipment supplied. For matching the Artificial Mains Network to connector systems not common in the Federal Republic of Germany, 2-mm-thick plates are supplied with the units. They may be fixed to the front panel of the ESH2-Z5 instead of Cekon-type socket 10 and earthed socket 2 and made for fitting other sockets.

A DC current of 4 x 32 A is permissible for the Cekon socket 10 and of 2 x 16 A for the single-phase socket. See section 2.5 for max. current-carrying capacity of the ESH2-Z5 with fan.

Test items with a separate earth terminal are earthed at terminal 8.

For normally hand-held equipment, a circuit simulating the effects of a human hand can be connected to terminal 1.

2.2.5 Test Setup

In order to ensure that measurements can be easily reproduced, the test setup is exactly defined in the regulations for interference measurements.

The Artificial Mains Network ESH2-Z5 complies with VDE 0876, CISPR Publ. 3 and the American FCC standards (Rules and Regulations Part 157).

The test setups required for the various standards are largely identical; a detailed description is given in the VDE regulations 0877.

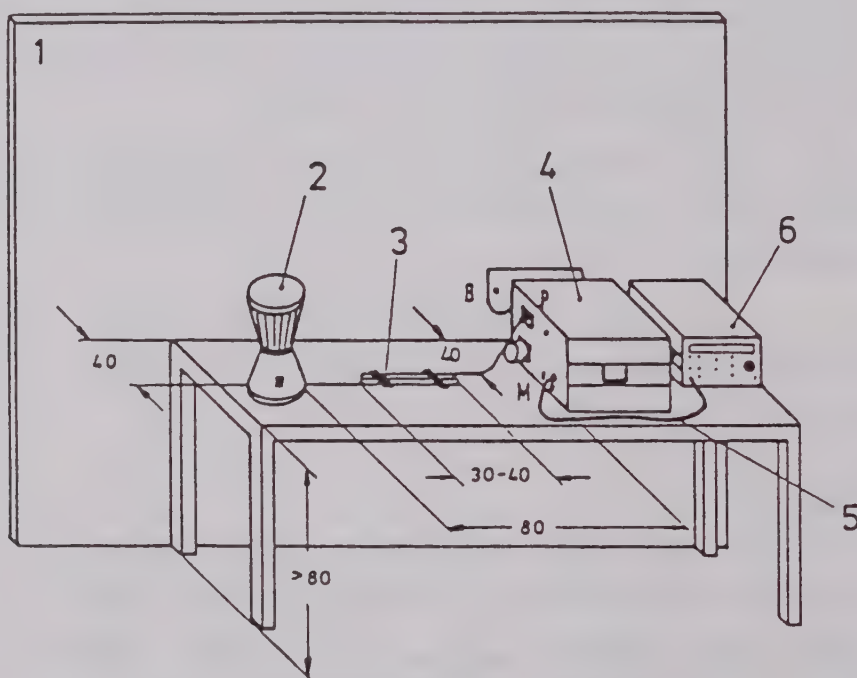
•
The device to be tested should be placed on a table made of non-conductive material which is at least 80 cm high, 40 cm in front of an earthed, conductive area (metal panel) at least 80 cm away from any other earthed metal areas.

Instead of the metal panel, the wall of a shielded room can also be used, provided that the device under test is placed at a distance of at least 80 cm from all other metal areas.

Put the Artificial Mains Network on the table at one end of the metal panel such that the connector for the test item is 40 cm away from the metal panel. Make a good RF connection between the earth terminal and the metal panel acting as signal ground.

The distance between the case of the test item and its connector on the Artificial Mains Network must be at least 80 cm. The line between the test item and the Artificial Mains Network must be put on the table parallel to the metal panel at a distance of 40 cm.

The cable between the Artificial Mains Network and the AC supply and the patch cord to the interference test receiver must be placed such that their position does not influence the test result. The test setup is shown in Fig. 2.



- 1) Metal panel, minimum size: 2 m x 2 m
- 2) Device under test
- 3) Cable, wound as shown above
- 4) Artificial Mains Network
- 5) Shielded patch cord
- 6) Interference test receiver
- B) Connector: Signal ground
- M) Connector: Test receiver
- F) Connector: Device under test

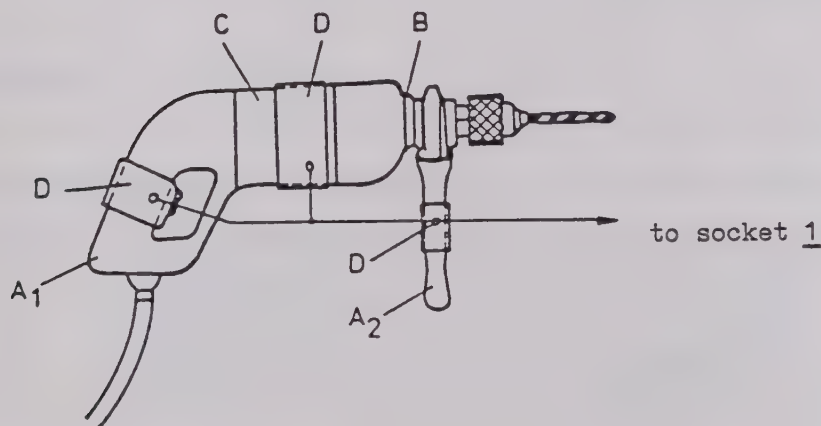
Fig. 2 Test setup and connection of test item to AC supply (dimensions in cm)

Test items not equipped with a fixed connecting cable are connected to the Artificial Mains Network by means of an unshielded line of 1 m length. In the case of items with fixed cables which are longer than 1 m, the cable is arranged as shown in Fig. 2.

Test items equipped with a separate earth terminal and which are not earthed via separate earth lines are earthed via an additional line. This line is connected to terminal 8 and should run parallel to the power line.

When carrying out measurements on equipment which is normally used hand-held (e.g. electric drills), the effect of a human hand is simulated by a network connected to terminal 1. The circuit simulating the effect of a human hand consists of a 200-pF capacitor connected in series with a 500-Ω resistor.

If the case of the test item is entirely made of metal, terminal 1 is simply connected to the case. If the case is made of isolating material, put a piece of metal foil around each of the handles and a 60-mm wide band of metal foil around that part of the case under which the connector to the motor is located. This band of foil is unnecessary if the user is not able to hold the device at that particular area. The foils are connected to one another and then to terminal 1. Fig. 3 gives an example of how the foils are to be fitted.



- A₁ and A₂) Handles
- B) Bushing of electric drill
- C) Case
- D) Metal foil

Fig. 3 Metal foils required when simulating the effects of a human hand holding an electric drill

2.2.6 Remote Control

Phase selection, carried out manually with switch 3, can also be remote controlled. Miniature relays, which connect the RF signal from the selected phase to output 7, are controlled via the 50-way socket 12. Pin allocation of socket 12 as shown in table 1.

Table 1

X11.21	control input L1
X11.22	control input L2
X11.23	control input L3
X11.46	control input neutral N
X11.47	control input PE floating
X11.48	input (+5 V) if necessary via R44
X11.50	0 V, not connected to chassis or earth line of the Artificial Mains Network

In the case of remote control, power supply via 16 is required.

When a phase is selected, the respective input must be set to 0 V (X11.50).

In order to avoid measurement errors, the control circuit must prevent more than one input being driven at a time. Fig. 4 shows how to control the Artificial Mains Network by means of a remote selector.

Terminals of socket 11

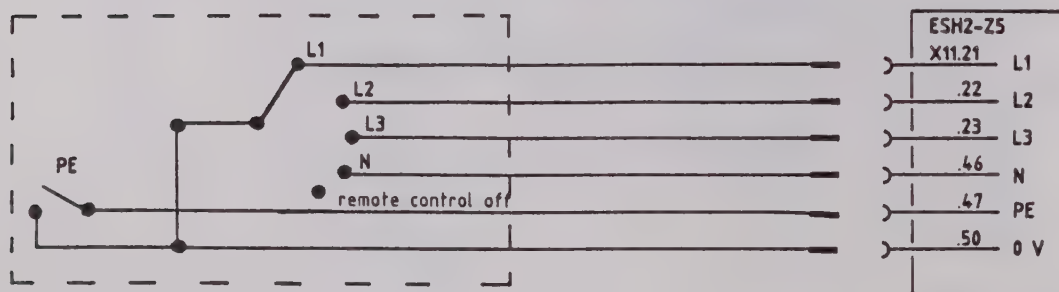


Fig. 4 Remote phase selector

As soon as a phase has been selected via socket 12, LED 4 REMOTE on the front panel lights up. While LED 4 is on, switch 3 is disabled.

2.2.7 Remote Control with Process Controller PUC

For remote control of the Artificial Mains Network we recommend to use the I/O Port option PUC-B7 (Ident No. 345.2811.02) of the Process Controller PUC. (Control is also possible with option PCA-B11 of Process Controller PCA 5. The Spectrum Monitor EZM has been designed with a view to remote control of the Artificial Mains Network).

We recommend to use Ports A and B.

Insert links BR3, BR9, BR11, BR13 and BR15 on the PC board.
(Address range 37864 to 37871; all free ports are used as outputs).

Code words used:
100 POKE 37867, 128: POKE 37871, 130

Pin allocation for controlling the Artificial Mains Network.

Pin No. PUC	Function	Pin No. ESH2-Z5	Function
5	A3	23	L3
6	A2	22	L2
7	A1	21	L1
8	AØ	46	N
16	BØ	47	PE
24	digital earth		0 V (TTL)

Programming:
Only 1 line of Port A is allowed to be connected to LOW level.
Consequently the programming commands for N, L1, L2, L3 are:

Function	Command
N	POKE 37864, 14
L1	POKE 37864, 13
L2	POKE 37864, 11
L3	POKE 37864, 7

Programming of PE:

Function	Command
PE grounded	POKE 37865, 1
PE floating	POKE 37865, Ø

In order to prevent interfering voltages from the controller affecting the Artificial Mains Network, filter the individual lines for instance when leading them through the wall of a shielded cabine.

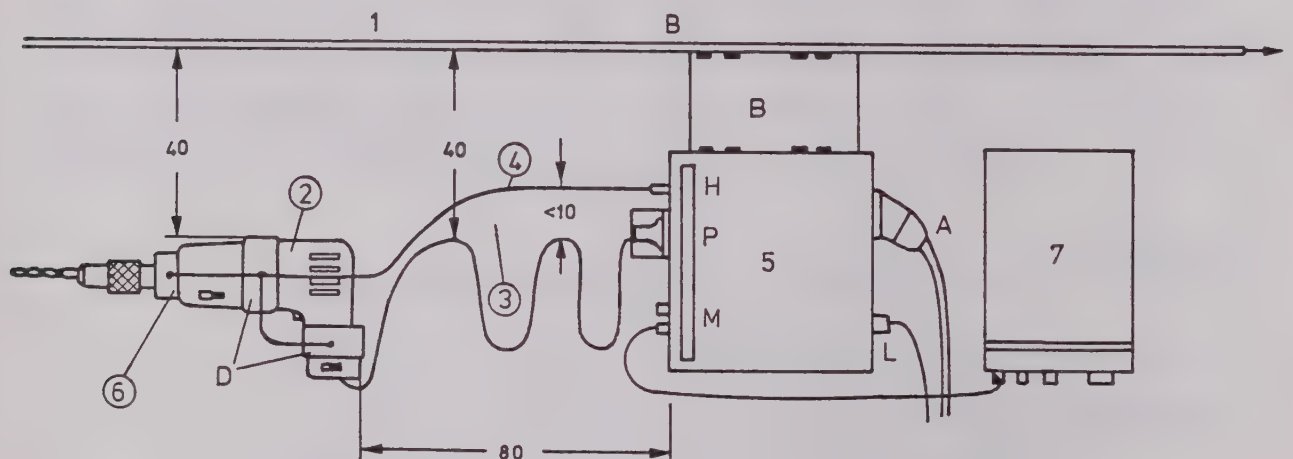
2.3 Operating Instructions

The test receiver (e.g. ESH2, ESH3) connected to socket 7 directly displays the noise voltage in dB μ V. A correction of values measured at low frequencies using a correction curve (as mentioned in VDE regulations 0876) is not required with the Artificial Mains Network ESH2-Z5 since its frequency response is flat between 9 kHz and 30 MHz.

One of the phases, or neutral, can be selected with switch 3 or via socket 12. The interference voltage can then be measured at output 7. In the remote control mode two LEDs of 4 (REMOTE and the LED of the switched phase) light up and switch 3 is ineffective. The remote control input is described in sections 2.2.6 and 2.2.7.

2.4 Example of Measurement

Fig. 7 shows the test setup required for interference measurements on an electric drill. The circuitry simulating a human hand is connected to three metal-foil bands (see section 2.2.5).



- 1) Metal panel, 2 x 2 m minimum
- 2) Device under test
- 3) Patchcord
- 4) Separate line to the hand simulator
- 5) Artificial Mains Network
- 6) Touchable metal bushing
- 7) Test receiver

- A) Connector for power supply
- B) Connector for signal ground (e.g. brass sheet 0.2 mm thick, low-inductance)
- P) Connector for test item
- H) Connector for circuitry simulating a human hand (metal foils D represent hand)
- M) Connector for test receiver
- D) Metal foils
- L) Power supply of fan
- ⊥ Earth, independent of the power supply

Fig. 7 Test item with circuitry simulating a human hand, seen from above (dimensions in cm)

KODAK APPARATUS DIVISION
METROLOGY SERVICES DEPARTMENT 442
TEST EQUIPMENT CALIBRATION PROCEDURE

CONTROL NUMBER: KA 117672
 DESCRIPTION: Artificial Mains Network DEPARTMENT 442 LAB A
 MFR/MODEL # ESE2-Z5 SHEET 1 OF
 WRITTEN BY: Mark Nunes DATE: 04-26-88
 CHECKED BY: DATE:
 REVISED BY: DATE:

EQUIPMENT REQUIRED

MANUFACTURER	MODEL NUMBER	DESCRIPTION	LOCATION
Hp	8753A	Network Analyzer	
Hp	85032B	Type N Calibration Kit	w/analyzer
Hp	(2) 8120-4779	APC 7 Cables	w/analyzer
Hp	3325A	Signal Generator	Lab
Hp	400 GL	RMS Voltmeter	Cabinets
Fluke	8506A	DMM	Lab
Hp	2225A	Think Jet Printer	Lab
R & S		Calibration Kit	Cabinet
			Box ?

This Procedure is to be used as a Supplement to the Rhode & Schwartz Calibration Tests.

3.2.1 DC Resistance

The Fluke 8506A is used in the 4 Terminal Resistance mode to Measure the resistance Between the Rear inputs and front inputs.

ie: Rear panel N to 3 Phase N 80 mOhms +20 %

ie: Rear panel N to 1 Phase N 80 mOhms +20 %

ie: Rear panel L1 to 3 Phase L1 80 mOhms +20 %

ie: Rear panel L1 to 1 Phase L1 80 mOhms +20 %

ie: Rear panel L2 to 3 Phase L2 80 mOhms +20 %

ie: Rear panel L3 to 3 Phase L3 80 mOhms +20 %

3.2.2 Input Impedance

The Hp 8753A is used to Measure The Impedance of the 1 Phase N, L1, 3 Phase N, L1, L2, L3 in respect to Ground with the to test receiver Port Terminated. Shield output to Port 2 with Aluminum foil.

Markers are to be Displayed at the following Frequencies.

300 Khz, 450 Khz, 10 Mhz, 30 Mhz. Don't Forget to Title Each Chart for the Line under test see attached Charts.

Load the procedure RSESH2Z5 off the disk in this Manual.

Attach the Equipment as in figure 1.
Preform a FULL 2-PORT Calibration

Connect a N(f) to Bnc (f) Adapter to Port 1 on the Network Analyzer. Connect the Bnc cable in the Calibration Kit to the Adapter on Port 1.

Hard wire the Bnc cable attached to Port 1 to the 3 Phase Ground and L1; Connect this to the ESE2-Z5 3 Phase input.

Select L1 on ESE2-Z5

Connect a N(m) to Bnc (m) Adapter to Port 2 on the Network Analyzer; Connect this to the To Test Receiver Port on the ESE2-Z5.

Measure S21 on the Network Analyzer allow Single Sweep and set Display as Per Chart 1.

Print this display and operating parameter as Per Chart 1.

Measure S-11 on the Network Analyzer allow Single Sweep and set Display as Per Chart 2.

Print this Display and Data as Per Chart 2.

Repeat the Underlined steps on Each Phase L2, L3, and N remember to put the Selector switch to the Line Being Tested.

Disconnect the 3 Phase connector on Port 1 cable and wire the 1 Phase Adapter between Ground and N.

Repeat the Underlined steps on N and L1; remember to put the Selector switch to the Line Being Tested.

3.2.3 RF Attenuation.

You will still be using the Network Analyzer as in the previous step to make this measurement.

Connect equipment as in figure 2.

NOTE You will need to Shield the front panel connector with aluminum foil to test attenuation.

Hard wire the Bnc cable attached to Port 1 to the 3 Phase rear input adapter between plug Ground and L1 also connect a wire between plug ground and chassis ground; Connect this to the ESE2-Z5 3 Phase Rear input.

Select L1 on ESE2-Z5

Connect a N(m) to Bnc (f) Adapter to Port 2 on the Network Analyzer. Connect the Bnc Cable in kit to PORT 2.

Hard wire the Bnc cable attached to Port 2 to the 3 Phase front input adapter between plug Ground and L1. this to the ESE2-Z5 3 Phase FRONT input.

Measure S21 on the Network Analyzer allow Continuous Sweep and set Display as Per Chart 1.

CHECK that the Network Analyzer Display Less than -40 dB from 300 Khz to 30 Mhz.

Repeat the Underlined steps on Each Phase L2, L3, and N remember to put the Selector switch to the Line Being Tested and to rewire both front and rear inputs to the same Lines.

Disconnect the 3 Phase connector on Port 1 cable and wire the 1 Phase Adapter between Ground and N.

Repeat the Underlined steps on N and L1.

Disconnect the Network Analyzer and cables on DUT.

3.2.4 DECOUPLING.

The Hp 3325A and Hp 400GL are used to do this test connect equipment as in figure 3.

Follow instruction in Rhode & Schwartz book.

Blue Tag as follows Fan and Temperature Switch.

Remote Control

Impedance Not Checked Below 300 Khz.

Impedance Accuracy as Per Charted Values.

*rsesh2z5*mn042788

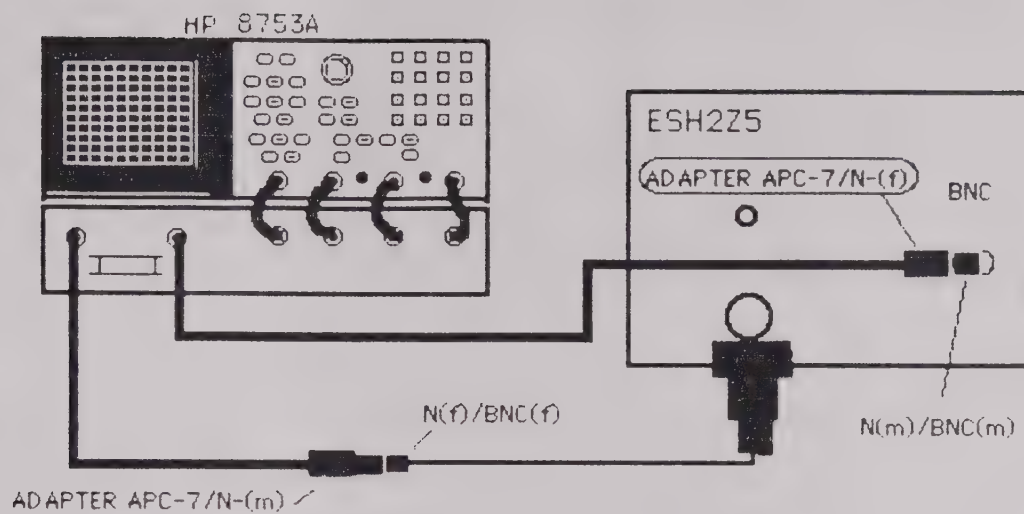


FIGURE 1

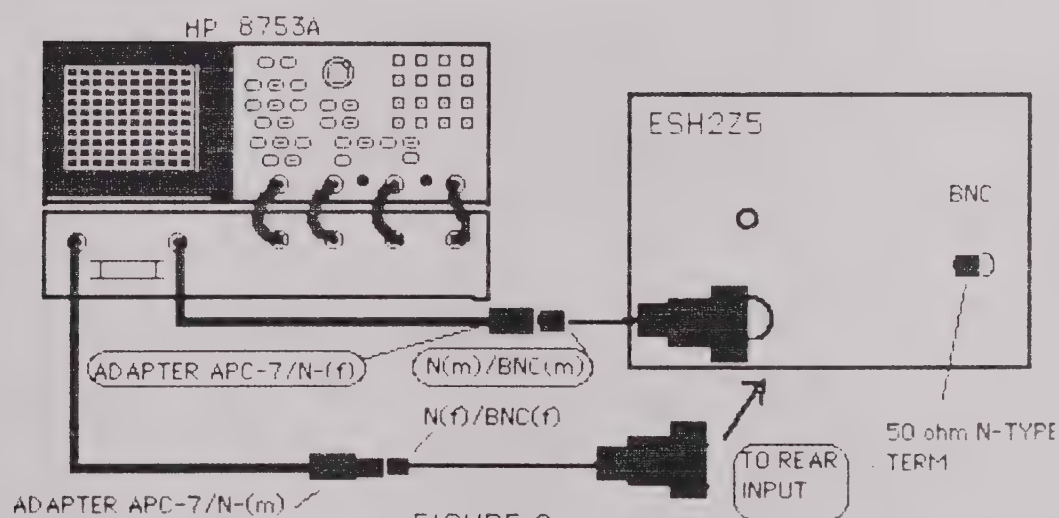


FIGURE 2

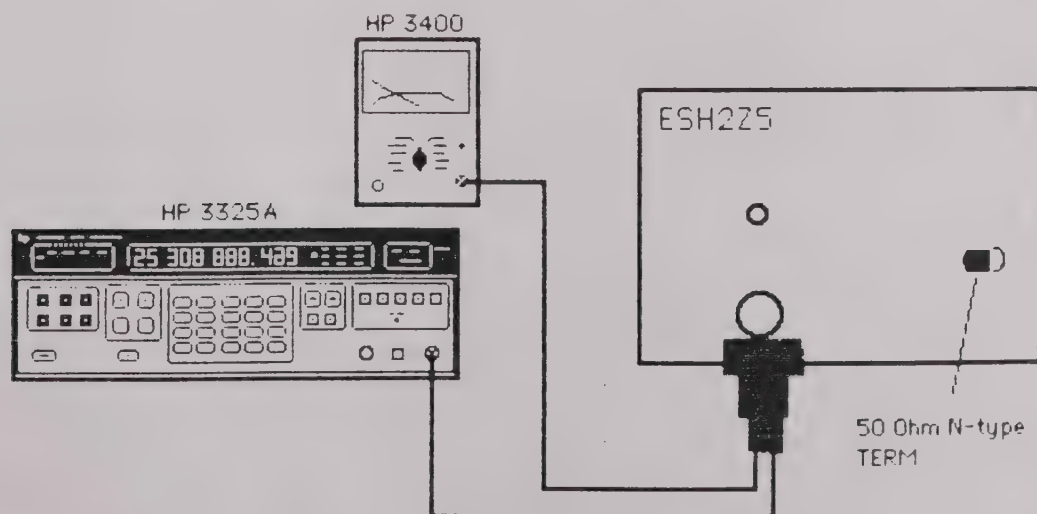


FIGURE 3

2.5 Permissible Power Losses of Current Paths

The resistance of each current path and the rms value of the current applied to it from the test item are decisive for the power losses in the Artificial Mains Network.

The resistance of each current path is typ. $0.088\ \Omega$ at ambient temperature (25 to 30°C) and typ. $0.12\ \Omega$ at max. temperature ($= 120^\circ\text{C}$) of coils L6 to L9.

At an ambient temperature of 30°C , the typical permanent load capacity of each path in the Artificial Network is $90\ \text{W}$, which corresponds to a DC current of $27\ \text{A}$.

Consequently, in case of currents above $27\ \text{A}$, the test item is driven intermittently in order to avoid damages on the coil varnishing.

Fig. 16 shows the temperature curve at coil L9 when a current of $32\ \text{A}$ is applied to each of the 4 paths of the Artificial Mains Network and the fan is running permanently.

Note:

t_r : Time for temperature increase from 30°C to 120°C

t_f : Time for temperature decrease from 120°C to 40°C

t_m : Time for temperature decrease from 120°C to 100°C

t_n : Time for temperature increase from 100°C to 120°C

Values for some currents:

I/A	t_r/min	t_f/min	t_m/min	t_n/min
25	∞		- b	-
32	26	27	3	8
50	5.5	27	3	1.3
70	2.2	27	3	0.6

Note:

If the connectors are properly fitted, currents above $32\ \text{A}$ are permissible for a short period of time. Even in case of intermittent operation of the test item, the average power of each path must not exceed $90\ \text{W}$. The temperature of coils L6, L7, L8 is only slightly lower when the same load is connected.

3.1 Required Measuring Equipment

Item	- o Type of instrument required specifications ● Recommended R&S instr.	Type	Order No.	Section
1	- o Vector analyzer ● Vector Analyzer with Tuner	ZPV ZPV-E1	291.4012.92 303.0510.02	3.2.2
2	- o Power supply 10 V/25 A ● Power supply 10 V/30 A	NGRE 10/30	100.8360	3.2.1
3	- o Voltmeter ● Digital Multimeter	UDL3	346.7117.02	3.2.1
4	- o RF millivoltmeter ● Millivoltmeter ● 10-V Insertion Unit 50-Ω termination	URV4 URV-Z2	292.5012.02 288.8010.55	3.2.3 3.2.4 3.2.5
5	- o Signal generator 9 kHz to 30 MHz ● AM/FM Signal Generator	SMK	348.0010.03	3.2.2 3.2.3 3.2.4

3.2 Checking the Rated Specifications3.2.1 DC Resistance

The true resistance between plug 15 at the rear and sockets 10 and 2 on the front panel should be 90 mΩ (±20%). In order to check at the same time the loading capacity of the terminals, the resistance should be measured at the maximum permissible current flow.

To do so connect a high-current power supply unit to 15 and 10 or 2 respectively. Now check in turn lines N, L1, L2, L3; between 15 and 2 only N and L1 need to be checked. Set a sufficiently high voltage on the power supply and limit the current to $I = 25 \text{ A}$ (for measurements between 15 and 2 limit the current to 16 A). The voltage is then measured direct at the respective terminals of the plugs on the Artificial Mains Network with a voltmeter. The DC resistance is calculated from $R = V/I$.

3.2.2 Input Impedance

The complex input impedance Z at sockets 2 and 10 is specified in the VDE regulation 0876. Fig. 8 shows the rated curve and the permissible tolerance of $\pm 20\%$.

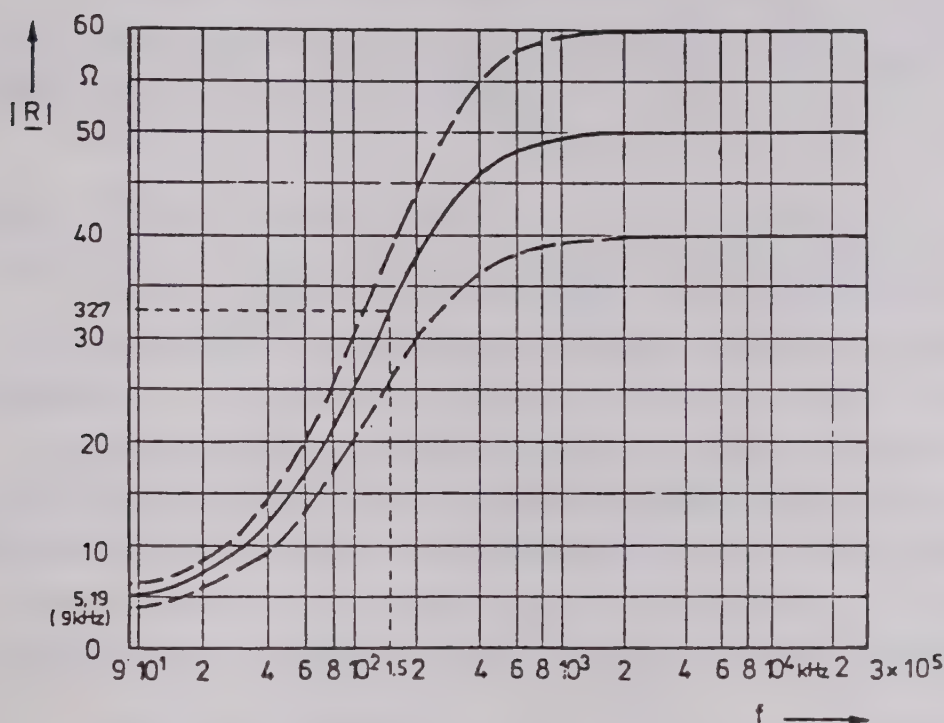


Fig. 8 Nominal input impedance curve

The input impedance is measured between terminals N, L1, L2, L3 of 10 and N, L1 of 2 and chassis ground. The measured value is indicated direct on a vector voltmeter such as the ZPV; a conversion will be necessary if a conventional reflection factor meter is used.

During measurement output 7 must be terminated into 50 Ω . In all positions of switch 3 the impedance must be within the tolerances shown above.

The measurement reference plane should be at sockets 2 or 10 respectively. For this reason the leads between the device under test and the Artificial Mains Network should be short or the shift of the reference plane must be taken into account.

If, in the case of high frequencies, the measured values vary when the chassis is touched, sheath waves are being produced in the coaxial leads. They can be eliminated if a high-permeability ferrite ring is slid over the test lead and an additional lead is connected between the chassis of the Artificial Mains Network and that of the measuring instrument.

3.2.3 RF Attenuation

In order to isolate the test circuit as much as possible from unwanted radio-frequency signals from the AC supply, an attenuation of at least 40 dB is required between power connector 15 and the connectors for items under test 2 and 10. This applies for a frequency range between 40 kHz and 30 MHz.

In order to determine the RF attenuation, take the earth terminal of plug 15 direct to chassis, so that the choke in the earth line is bypassed, and input and output are connected to a common earth.

Connect in turn a 50- Ω signal generator to terminals N, L1, L2 and L3 of plug 15 and to the earth. Terminate the corresponding terminals of sockets 2 and 10 into 50 Ω and measure the RF voltage with an RF millivoltmeter. From the difference between this and the voltage measured when the signal generator is connected direct to the 50- Ω termination, the RF attenuation can be determined.

If, in the case of high voltages, the measured value varies when the chassis is touched, sheath waves are being produced. They can be eliminated with highly permeable ferrite rings slid onto the coaxial lines at 15 and 2 or 10 respectively.

After the measurement, the earth line of 15 is again connected to the choke.

3.2.4 Decoupling

An attenuation of at least 40 dB is required between any two terminals of socket 10 - except for the earth line - in the frequency range between 40 kHz and 150 kHz. The same applies to terminals N and L1 of 2.

In order to check the attenuation connect the signal generator first to the N terminal of 10 and the RF millivoltmeter in parallel with the 50- Ω termination at L1 and measure the decoupling between N and L1. Do the same between N-L2, N-L3, L1-L2, L1-L3, L2-L3 and N-L1 of socket 2.

Eliminate sheath waves as described in 3.2.3.

3.2.5 Switch Operation and Remote Control

Switch 3 connects the RF signal of the selected phase to output 7. For this purpose a signal of about 1 MHz from the signal generator is applied successively to the various terminals of sockets 2 and 10 and the RF voltage is measured at socket 7 which is terminated into 50 Ω . The attenuation between the connector for the item under test and the signal generator is determined from these two signal levels.

If the phase of 2 or 10, to which the signal generator is connected, is selected together with 3 the attenuation should be < 1 dB. In all other cases the attenuation must be > 40 dB. (Check all combinations).

For checking the remote control, a phase selector is connected to 12 (see also 2.2.6 and 2.2.7). Every time a phase is selected two LEDs of 4 must light.

As required with manual phase selection check the attenuation between the connector for the item under test and that of the signal generator. As long as LED 4 is on, switch 3 must be disabled.

3.2.6 Fan and Temperature Switch

If switch 6 is in position CONT the fan 13 runs continuously. In position AUTO the fan starts running as soon as one of the 50- μ H coils reaches a temperature of about 65°C and it is switched off again when the temperature has dropped to about 45°C.

The operation of the temperature switches is checked separately for each line. As described in 3.2.1 a current of about 25 A should flow between 10 and 14. As soon as the 50- μ H coils reach a temperature of about 65°C (after about 10 minutes) the fan starts running and it is stopped when the temperature drops again.

3.3 Electrical Maintenance

The Artificial Mains Network requires no regular electrical maintenance as it contains no electrical components which are subject to heavy loading or to wear and tear. Furthermore, no adjustment is necessary.

3.4 Mechanical Maintenance

Regular mechanical maintenance is not required. If, for instance during transport, the instrument has experienced severe jolting, the cable connections at socket 10, at the inductances and at the choke in the earth line should be checked and, if necessary, the screws tightened. Furthermore make sure that the four temperature switches have not moved out of line and that they lie flat on the coils.

3.5 Storage

The Artificial Mains Network may be stored between -25°C and +70°C over a long period of time.

4.1 Electrical Function4.1.1 General

The Artificial Mains Network ESH2-Z5 is used for measuring RF-noise voltages. RF noise voltages produced by electrical devices are propagated along the AC supply lines. Via the Artificial Mains Network the interfering signal is applied to an RI test receiver (e.g. ESH3) where the voltage is indicated.

During the measurement the Artificial Mains Network applies mains voltage to the item under test and at the same time terminates the connectors on the item under test with a defined simulated impedance for RF signals.

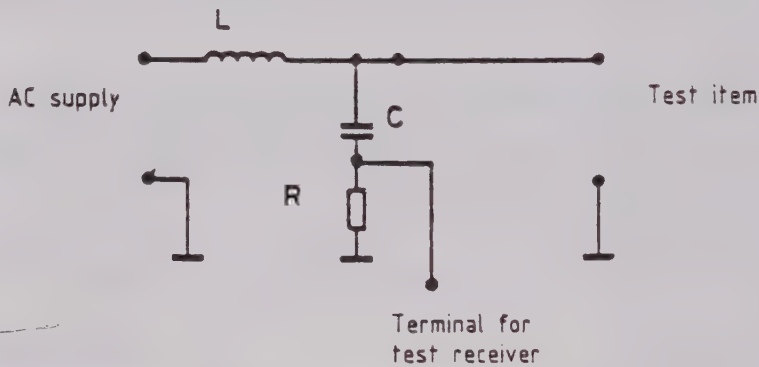


Fig. 9 Basic circuit of an artificial mains network

Fig. 9 shows the operating principle of an artificial mains network. The mains voltage is applied to the test item via a low-pass filter with the inductance L , which at the same time prevents interfering RF signals from the supply mains reaching the test circuit. The test receiver is connected to the device under test via a highpass filter with the capacitance C . Thus the test receiver indicates the noise voltage produced by the item under test.

In order to ensure that measurements can be reproduced, the input impedance of an artificial mains network at the connectors for the test items, i.e. the simulated impedance, is defined in the regulations for interference measurements (VDE 0876, CISPR, FCC). The input impedance of the test receiver is part of the simulated impedance.

For measurements on devices requiring three-phase supply, the Artificial Mains Network ESH2-Z5 is equipped with four simulating networks for the phases L1, L2, L3 and for neutral N. In compliance with the VDE 0876 regulations the earth line PE may be interrupted and connected to the reference ground via a choke.

The test receiver output can be connected to one of the four test circuits by means of a selector or by remote-control. The test receiver then indicates the (unbalanced) noise voltage against the reference ground.

The Artificial Mains Network ESH2-Z5 corresponds to the "V-shaped artificial network for simulating supply networks" described in the VDE regulations 0876, but it also complies with the requirements to CISPR and the American FCC standards. It covers a test frequency range from 9 kHz to 30 MHz. Fig. 10 shows the circuit representing the simulated impedance.

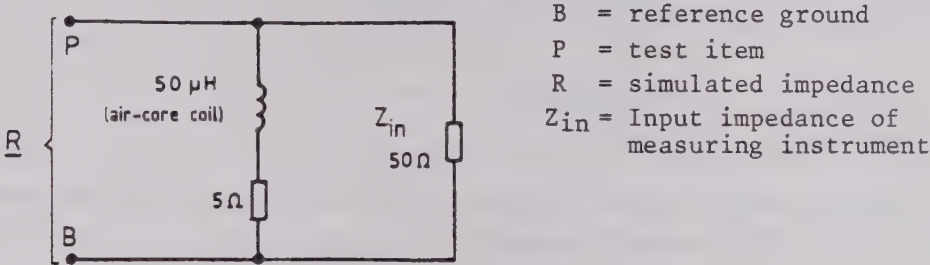


Fig. 10 Circuit equivalent to the simulated impedance ($50\ \mu\text{H} + 5\ \Omega$) shunted by $50\ \Omega$ in the test frequency range 9 to 150 kHz (30 MHz)

The input resistor of the test receiver represents the $50\text{-}\Omega$ impedance Z_{in} , which corresponds to the impedance characteristic shown in Fig. 11.

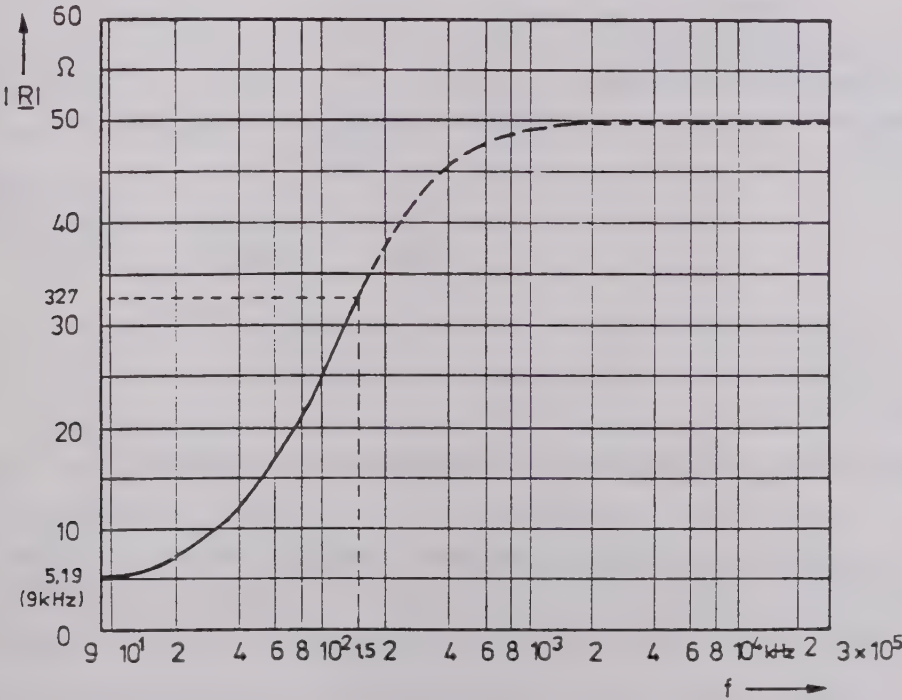


Fig. 11 Impedance characteristic of the simulated impedance ($50\ \mu\text{H} + 5\ \Omega$) shunted by $50\ \Omega$ in the test frequency range 9 to 150 kHz (30 MHz)

The inductive impedance of $5\ \Omega$ in the very-long-wave range approaches a real impedance of $50\ \Omega$ in the short-wave range. This corresponds well to the impedance characteristic of a modern 220-V AC supply network. Compared to the "classic" mains simulator with an impedance of $150\ \Omega$ the Artificial Mains Network with an impedance of $50\ \Omega$ offers the following advantage:

The coils in the low-pass filter may be air-core coils; ferrite cores are not required. This avoids saturation effects and consequently non-linearities which, especially with measurements on semi-conductor regulators with a non-sinusoidal operating current, may falsify the test results.

4.1.2 Basic Circuit Description

(see circuit diagram 338.5219 S)

Fig. 12 shows a basic circuit diagram of the Artificial Mains Network ESH2-Z5. Only one of the four phases is shown.

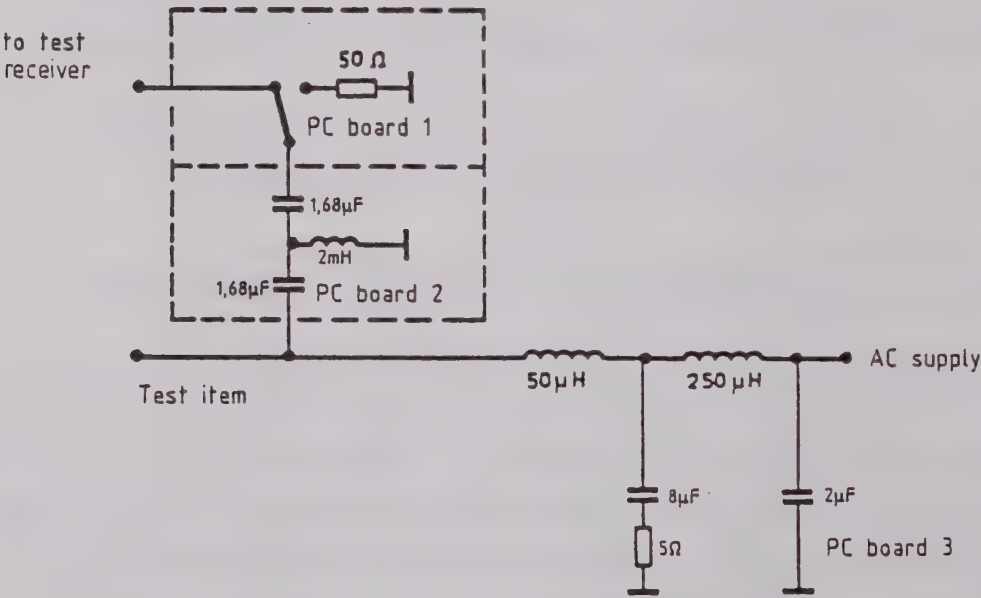


Fig. 12 Basic circuit diagram of the Artificial Mains Network

A low-pass filter with two coils and two capacitors RF-isolates the item under test from the AC supply, which is supplied with the necessary operating current. The RF noise voltage produced by the device under test is fed into a $50\text{-}\Omega$ termination via a high-pass filter, if the phase has been selected, or via the output to a test receiver.

4.1.2.1 PC Board 1

Board 1 receives the RF signals from the four terminals N, L1, L2, L3 of the test-item connector on board 2.

A signal is applied to socket C13 via switch S1 or the relays K1 to K4, K6; the other sockets are terminated into 50 Ω .

With manual operation only switch 1 is enabled, no current is applied to the relays.

The 0-V terminal 1B of X12 is not taken to chassis ground in order to avoid disturbing the remote control. Phase selection is remote controlled via terminals 2B (for L3), 3B (for L2), 4B (for L1) and 5B (for N).

The corresponding input is set to 0 V so that the following transistor (V1 to V4) becomes conductive and relay (K1 to K4) is energised. As soon as one of the control inputs is at 0 V, transistor V6 is driven via diodes V12, V13, V14, V15, and switches the relay K6. It disconnects switch S1 from the RF output X13.

In order to make PE "floating" with respect to RF, X12.4A (X12.1B) is taken to 0 V. PE (X4.PE and X6.PE) is isolated from signal ground with K7. In the frequency range of the AC supply choke L10 (1.6 μ H) in the earth line ensures low-impedance earthing of test items.

4.1.2.2 PC Board 2

Board 2 is fitted directly behind the Cekon socket 10 (X4) on the front panel. Here the terminals of Cekon socket 10 and the earthed socket 2 (X6) are connected to the four lines (for N, L1, L2, L3) to the four PC boards 3. Board 2 includes four high-pass filters which are also connected to these four junction points. Via these points the interfering RF signal of the device test reaches board 1 and the test receiver output.

The high-pass filters are three-stage 50- Ω filters with a limit frequency of 2 kHz. Unlike the circuit shown as an example in the VDE regulation 0876, no output correction curve is required for the range from 9 kHz to 30 MHz. At the same time the steep rise of attenuation (18 dB/octave) ensures a better suppression of the low-frequency components of the interference and of the AC supply voltage.

Board 2 also holds the components of the circuit simulating the user's hand R18 and C31.

4.1.2.3 PC Board 3

Board 3 is included four times in the Artificial Mains Network. It carries the LC low-pass filter which RF-isolates the connector for the item under test and the AC supply connector, in order to eliminate interferences from the supply mains. The operating current of the device under test passes the inductances (permanent current max. 25 A). The input impedance at terminal 3 is part of the simulated impedance. R1 is the discharge resistor for C₁ and C₂. Otherwise the circuit complies with the example shown in the VDE regulation 0876.

4.1.2.4 Chassis and Earth Connection

The earth line of the Cekon plug 15 (X1) is taken to chassis via choke L16. The choke prevents interferences on the earth line reaching the signal ground. In addition to the screw connections, some parts of the chassis are interconnected by cables to ensure perfect earthing. The parts concerned are front panel, rear panel, the two upper side struts and the left side panel which carries the contacts for the signal ground and therefore is not anodized to reduce the contact resistance. All four PC boards 3 are connected to the upper struts by means of cables (see earth line connections in 338.5219 S).

4.1.2.5 Fan

When switch S2 (6) on the front panel is in position CONT, the fan runs permanently. In position AUTO it is triggered by one or more of the temperature switches F2 to F5. They are fitted to the 50- μ H coils L1 to L4 and close the circuit if their temperature exceeds 50°C. The temperature on the coil surface is then about 65°C. At about 45°C on the coil surface the circuit is interrupted again. Resistors R9 on the holders of the temperature switches are inserted for attenuating RF resonances.

4.2 Mechanical Construction

The Artificial Mains Network ESH2-Z5 is housed in a cabinet which is 19" wide and 6 units high. It is not intended for insertion into a rack; it is always operated in a defined test setup (see 2.2.5). Therefore no handles are provided on the front panel. The unit can be carried by the side handles which avoids that plug 15 is damaged during transport.

The test setup described in 2.2.5 requires a good connection of the Artificial Mains Network to a signal ground. The left side-wall is not anodized, to ensure a perfect ground contact.

4.2.1 Layout of Subassemblies

Fig. 13 shows the layout of subassemblies and inductances in the instruments as seen from above:

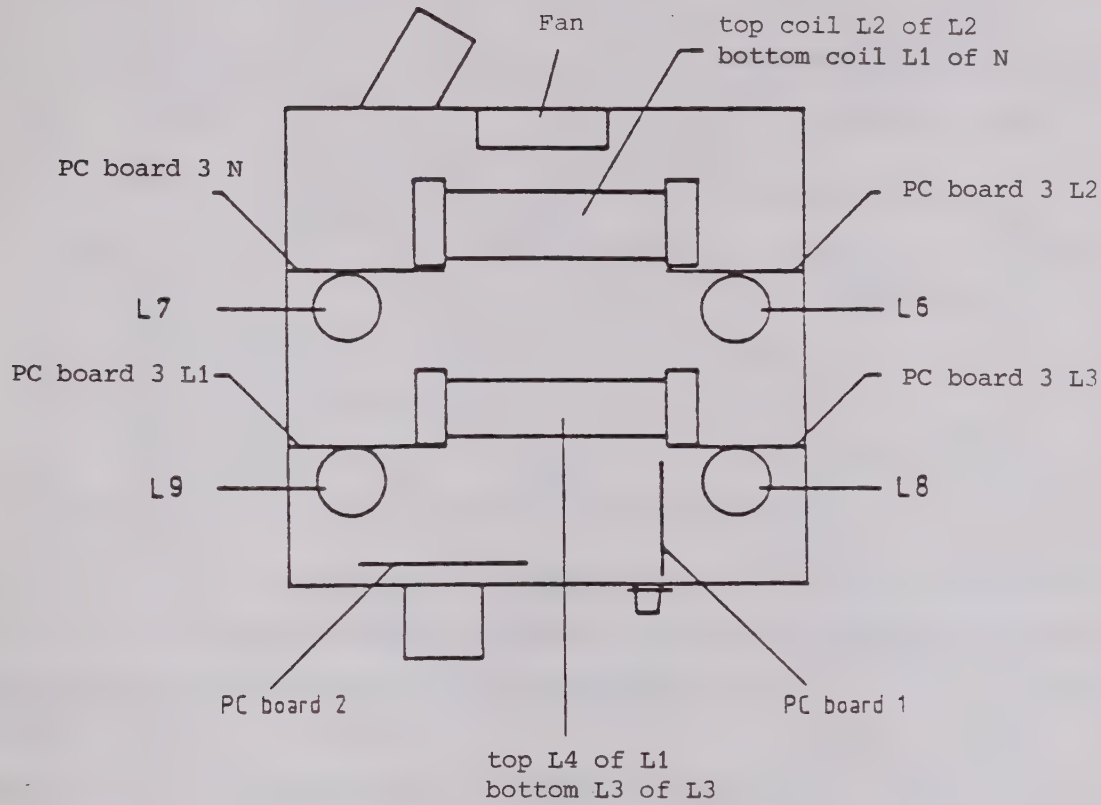


Fig. 13 Layout of subassemblies

PC board 3 is provided 4 times: for phases L1, L2, L3 and neutral N.
For wire colours see table 3.

<u>Table 3</u>	Colours of wires
N	light blue
L1	black
L2	brown
L3	black
earth line signal ground	green-yellow

5 Repair

5.1 Required Measuring Equipment

Item	- o Type of instrument required specifications ● Recommended R&S instr.	Type	Order No.	Section
1	- o Vector analyzer ● Vector Analyzer with Tuner	ZPV ZPV-E1	291.4012.92 303.0510.02	5.2.2
2	- o Power supply 10 V/25 A ● Power supply 10 V/30 A	NGRE 10/30	100.8360	5.2.1
3	- o Voltmeter ● Digital Multimeter	UDL3	346.7117.02	5.2.1 5.2.5
4	- o RF millivoltmeter ● Millivoltmeter ● 10-V Insertion Unit 50-Ω termination	URV4 URV-Z2	292.5012.02 288.8010.55	5.2.3 5.2.4
5	- o Signal generator 9 kHz to 30 MHz ● AM/FM Signal Generator	SMK	348.0010.03	5.2.2 5.2.3 5.2.4

5.2 Troubleshooting

After loosening four screws, each cover plate can be removed.

After unscrewing both side panels (two earth cables must be disconnected at the left-hand side) all test points are accessible. Instructions for removing the subassemblies are given in section 5.4.

5.2.1 DC Resistance

The true resistance between plug 15 at the rear and sockets 2 and 10 on the front panel should be 90 m Ω ($\pm 20\%$). If this is not the case check the instrument with the test setup described under 3.2.1.

With a constant current on the path to be checked measure the voltage at socket 10 on the front panel against various test points and then calculate the value of each individual resistance from the total resistance.

Table 4 Typical distribution of the resistance of one path

Socket <u>10</u> on the front panel }	< 1 mΩ
Terminal on board 2 from socket <u>10</u> }	< 1 mΩ
Terminal on board 2 to board 3 }	3 mΩ
Terminal on board 2 from board 2 }	< 1 mΩ
Terminal of 50-μH coil (L6, 7, 8, 9) }	25 mΩ
Terminal of 50-Ω coil (L6, 7, 8, 9) }	
L1 2, 3, 4) }	< 1 mΩ
Terminal of 250-μH coil (L1, 2, 3, 4) }	56 mΩ
Terminal of 250-μH coil (L1, 2, 3, 4) }	
to plug <u>15</u> }	< 1 mΩ
Terminal on board 3 }	
to plug <u>15</u> }	3 mΩ
Plug <u>15</u> }	

The 250-μH coils (L1, 2, 3, 4) with 56 mΩ and the 50-μH coils (L6, 7, 8, 9) with 25 mΩ provide the main part of the total resistance. If the measured value is considerably below the rating, the insulation is defective (e.g. due to overload) and the coil must be replaced.

The resistance of two successive terminals must be < 1 mΩ. If this is not the case, clean the contact surfaces and screw the terminals on tightly.

5.2.2 Input Impedance

If the input impedance measured at sockets 2 and 10 considerably deviates from the rated value of the respective path, first check board 2:

Break the connection of the defective path to the 50-μH coil (L6, 7, 8, 9) and also the coaxial connection to board 1. Terminate this contact on board 2 into 50 Ω. The impedance meter must indicate about 50 Ω (real resistance) between 9 kHz and 30 MHz. If this is not the case a component of the high-pass filter on board 2 is defective.

If board 2 has been checked and no fault been detected, remove the 50-Ω resistor and connect again the coaxial line towards board 1. Terminate socket 7 on the front panel into 50 Ω. The impedance meter must again indicate a real resistance of 50 Ω between 9 kHz and 30 MHz. If this is not the case the fault must be on board 1.

If board 1 is also fault-free, connect the 50-μH coil again to board 2. The impedance must be as shown in Fig. 8; if not board 3 is defective.

5.2.3 RF Attenuation

The measurement of the RF attenuation between plug 15 and the sockets 10 and 2 on the front panel is described in section 3.2.3. Unsatisfactory RF attenuation at high frequencies (30 MHz) suggests capacitive crosstalk between input and output. In this case check the positioning of the cables of the respective path. If the RF attenuation is too low with low frequencies (< 1 MHz) check the inductors, especially coils L6 to 9 and the capacitors, in particular C2, and their contacts.

5.2.4 Decoupling

Measuring the decoupling is described in section 3.2.4. If the decoupling is insufficient first check the position of cables W7, W8, W9, W11 between board 2 and the four boards 3. They should form a star and diverge with a maximum space between each other and must not touch. Check also the ground connection (PE) of sockets 2 and 10.

5.2.5 Switch Operation and Remote Control

The function of the phase switch and of the relays for remote control is described in sections 3.2.5 and 4.1.2.1. In the case of malfunction trace the signal path from the inputs X21, X22, X23, X24 to the output X13 with an ohmmeter. Sections 2.2.6 and 2.2.7 describe the remote control facility. In the case of a fault first measure at plug X12 on board 1. Table 5 shows the DC voltages measured against terminal 1B of X12.

Table 5 Control signals at connector X12

Remote controlled:	5A	5B	4B	3B	2B
no phase	(+5 V)	+5 V	+5 V	+5 V	+5 V
N	(+5 V)	0 V	+5 V	+5 V	+5 V
L1	(+5 V)	+5 V	0 V	+5 V	+5 V
L2	(+5 V)	+5 V	+5 V	0 V	+5 V
L3	(+5 V)	+5 V	+5 V	+5 V	0 V
PE floating	-	-	-	-	0 V

5.3 Adjustment

Adjustments are not required.

5.4 Electrical Repair

In the course of an electrical repair only defective components will be replaced under normal circumstances, subassemblies will only be replaced in case of serious damage. Replacing components is not critical, if the spares are produced according to the enclosed parts list.

After the repair refit the earth lines as shown in 338.5219 S.

5.5 Mechanical Repair

Mechanical repair is seldom required as the instrument comprises no parts that are subject to considerable wear and tear.

5.6 Spare Parts

5.6.1 Electrical Spares

All components and subassemblies are subject to a stringent quality control prior to their incorporation. In order to ensure maximum reliability for parts from other manufacturers e.g. resistors, capacitors, special conditions demanded by R&S must be met by the manufacturers. For this reason we recommend to use only original spares if a component has become defective.

When ordering a spare part please state:

Type, order number and serial number of the instrument, number of parts list, designation and order number of the respective part.

5.6.2 Mechanical Spares

The following table lists those parts that protrude either at the rear or at the front of the instrument and which are likely to be damaged first.

Position in the Fig.	Designation	Stock number (order number)
<u>1, 8, 17</u>	Knurled terminal	078.0938.00
<u>10</u>	Cekon socket 3 phases + N + $\underline{\underline{\perp}}$, 220/380 V	338.6621.00
<u>2</u>	Earthed socket	338.6650.00
<u>3</u>	Rotary knob	042.0821.00
<u>7</u>	BNC socket	017.6636.00
<u>12</u>	50-way female connector	018.5927.00
<u>15</u>	Cekon plug, 3P+N+ $\underline{\underline{\perp}}$ 220/380 V	338.6638.00



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Bilder
Figures

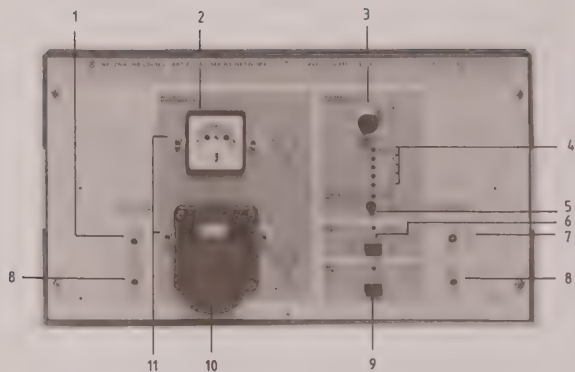


Bild 14 Frontansicht
Fig. 14 Front panel

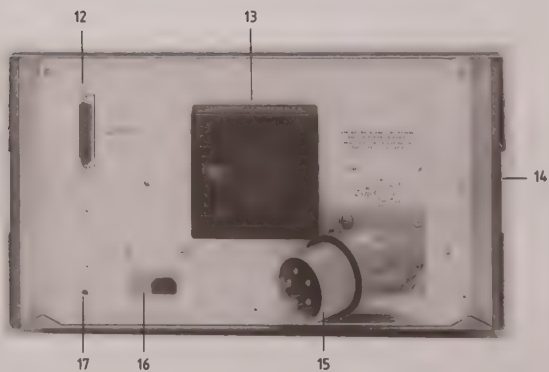


Bild 15 Rückansicht
Fig. 15 Rear panel

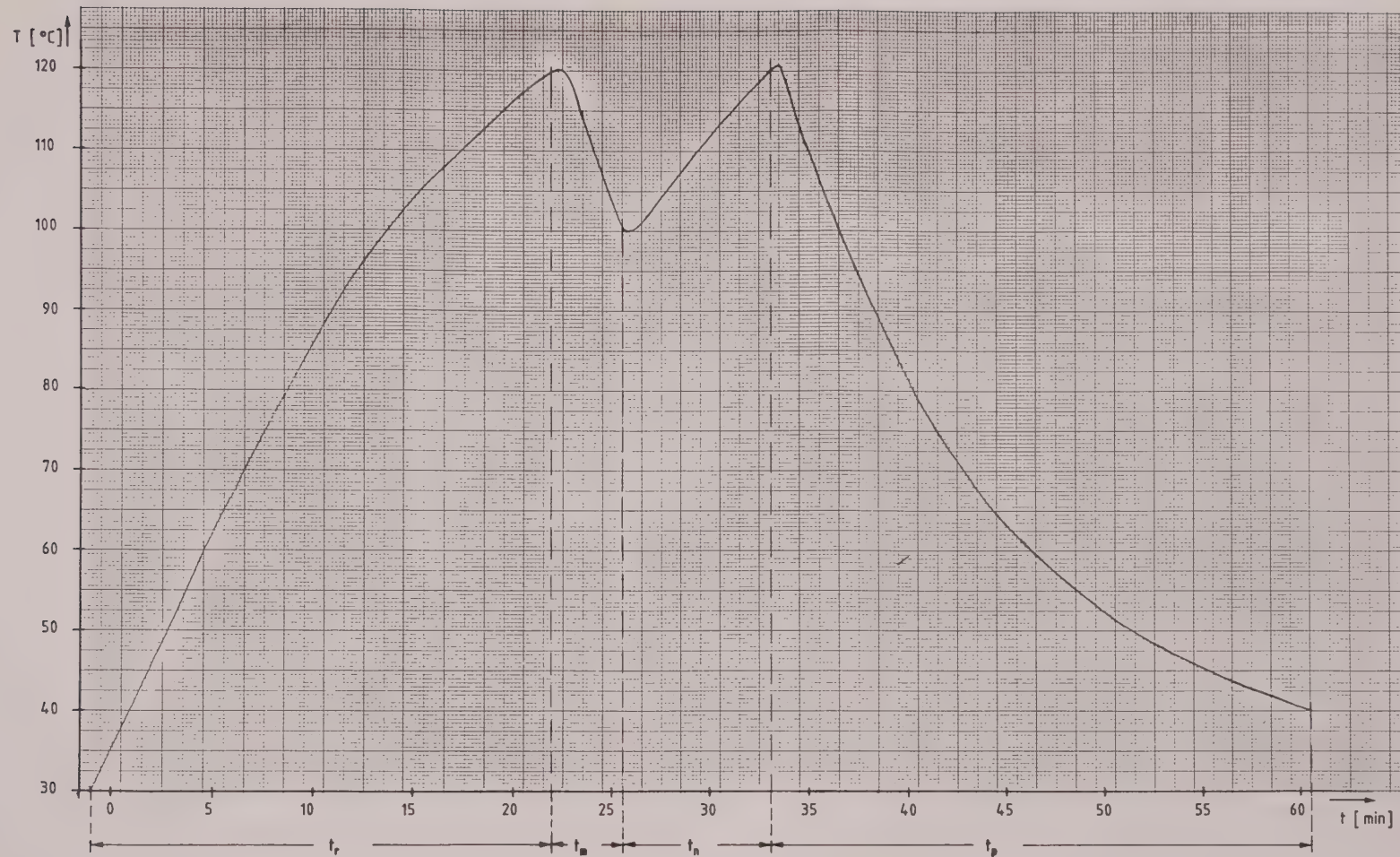


Bild 16 Temperaturverlauf in Spule L9 bei Betrieb der Netznachbildung mit 32 A pro Pfad

Fig. 16 Temperature curve of coil L9 if 32 A are applied to each path of the Artificial Mains Network



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Schaltteillisten
Stromläufe
Bestückungspläne
Parts lists
Circuit diagrams
Components plans


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AI

 Datum
Date

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 Schalteilliste für
Parts list for

ESH2-Z5 NETZNACHBILDUNG

 Sachnummer
Stock No.

338.5219.01

SA

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1

 Kennzeichen
Component No.

 Benennung/Beschreibung
Designation

 Sachnummer
Stock No.

 enthalten in
contained in

 A1 ED PLATTE 3 338.6673
PLATE 3

 A2 ED PLATTE 3 338.6673
PLATE 3

 A3 ED PLATTE 3 338.6673
PLATE 3

 A4 ED PLATTE 3 338.6673
PLATE 3

 C3 CC 10PF+-0,25PF3X4NP0 087.6429 338.6715
CAPACITOR
VALVO 2222 678 09109

 C4 CC 10PF+-0,25PF3X4NP0 087.6429 338.6715
CAPACITOR
VALVO 2222 678 09109

 C5 CE 1000UF10+50% 16V 15X30 087.0437 338.6715
ELECTROLYTIC CAPACITOR
ROEDERST ELKO EK 1000/16

 C6 CC 10PF+-0,25PF3X4NP0 087.6429 338.6715
CAPACITOR
VALVO 2222 678 09109

BIS/TO

 C9
C10 CE 470UF-10+50% 25V 15X25 087.0608 338.6715
ELECTROLYTIC CAPACITOR
ROEDERST ELKO EK470/25

 C11 CS 1UF+-10%630/250V 338.6573 338.6415
CAPACITOR
SIEMENS B 81121-C-B60

 C13 CS 1UF+-10%630/250V 338.6573 338.6415
CAPACITOR
SIEMENS B 81121-C-B60

 C15 CK 1UF+-10%50V5RM MKT 099.2998 338.6715
CAPACITOR
WIMA MKS2/50/1UF/10%

 C16 CS 1UF+-10%630/250V 338.6573 338.6415
CAPACITOR
SIEMENS B 81121-C-B60

 C18 CS 1UF+-10%630/250V 338.6573 338.6415
CAPACITOR
SIEMENS B 81121-C-B60

 C20 CK 1UF+-10%50V5RM MKT 099.2998 338.6715
CAPACITOR
WIMA MKS2/50/1UF/10%

 C21 CK 1,0UF+-10%160V RUNDB. 024.7411 338.6415
PLASTIC-FOIL CAPACITOR
ROEDERST MKT1813-510/10%

 C23 CK 1,0UF+-10%160V RUNDB. 024.7411 338.6415
PLASTIC-FOIL CAPACITOR
ROEDERST MKT1813-510/10%

 C25 CK 1UF+-10%50V5RM MKT 099.2998 338.6715
CAPACITOR
WIMA MKS2/50/1UF/10%

 C26 CK 1,0UF+-10%160V RUNDB. 024.7411 338.6415
PLASTIC-FOIL CAPACITOR
ROEDERST MKT1813-510/10%

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 ROHDE & SCHWARZ		Äl Datum Date	Schaltteilliste für Parts list for ESF2-Z5 NETZNACHBILDUNG	Sachnummer Stock No.	Blatt Page
22		0387		338.5219.01 SA	2
Kennzeichen Component No.	Benennung/Beschreibung Designation	Sachnummer Stock No.	enthalten in contained in		
C28	CK 1,0UF+-10%160V RUNDG. PLASTIC-FOIL CAPACITOR	024.7411	338.6415		
C30	ROEDERST MKT1013-510/10% CK 1UF+-10%50V5RM MKT CAPACITOR	CK 099.2998	338.6715		
C31	WIMA MKS2/50/1UF/10% CC 200PF 2% N750/IR 3R0HR CERAMIC CAPACITOR	022.3325	338.6415		
C33	DRALORIC N750/IB200/2RR3X20LC CK 1UF+-10%50V5RM MKT CAPACITOR	CK 099.2998	338.6715		
C100	WIMA MKS2/50/1UF/10% CK 2UF+-10%400V30,5X56MKP NUR VAR : 33 53	338.6609			
C110	RIFA PHH481MC720 CK 2UF+-10%400V30,5X56MKP NUR VAR : 33 53	338.6609			
C120	RIFA PHH481MC720 CK 2UF+-10%400V30,5X56MKP NUR VAR : 33 53	338.6609			
C130	RIFA PHH481MC720 CK 2UF+-10%400V30,5X56MKP NUR VAR : 33 53	338.6609			
E1	RIFA PHH481MC720 EV 119X119X38 44L/S 220V BLOWER EBM LUEFTER W2S107-AA01-	EV 070.5224			
F1	SS SCHMELZS.T500 DIN41662 FUSE	SS 020.7352			
F2	WICKMANN TO,5 DIN 41662 TROP ST SCHLIESSER 50GRD C +-3 LOCK	ST 082.1058			
BIS/TO F3 F5	TEXAS N. K-PL. ST2111/2112 ST SCHLIESSER 50GRD C +-3 LOCK	ST 082.1058			
F11	TEXAS N. K-BL. ST2111/2112 SU 90V RD 6X4,6 DRAHTANS. VOLTAGE DISCHARGER	335.3421	338.6715		
BIS/TO F14	SIEMENS M11-C90/069-X451				
H1	AF HLMP3401 LED GE RD5 LED HEWLETT HLMP3401	AF 092.8703	338.6715		
BIS/TO H8					
K1	SN GEPOLT 5V 2A+2R RELAY SDS S2-5V GEHAEUSE SCHW.	SN 456.9559	338.6715		
		338.5219.01 SA	BL 2+		

**ROHDE & SCHWARZ**

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Datum
DateSchaltteilliste für
Parts list for

ESP2-Z5 NETZNACHBILDUNG

Sachnummer
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338.5219.01 SA

3

Kennzeichen
Component No.Benennung/Beschreibung
DesignationSachnummer
Stock No.enthalten in
contained in

BIS/TO

K6

K7

SN GEPOLT MONOST.5V 2XUM
NUR VAR : 33 53
RELAY
SDS SP2-DC5V

338.5448

L1

SPULE 250UH
COIL 250UH

338.5525

L2

SPULE 250UH
COIL 250UH

338.5525

L3

SPULE 250UH
COIL 250UH

338.5525

L4

SPULE 250UH
COIL 250UH

338.5525

L6

SPULE 50UH
COIL 50UH

338.5577

L7

SPULE 50UH
COIL 50UH

338.5577

L8

SPULE 50UH
COIL 50UH

338.5577

L9

SPULE 50UH
COIL 50UH

338.5577

L10

LD SCHUTZLEITERDROSSEL
NUR VAR : 33 53

338.6509

L11

LD SPULE
COIL

338.6596

338.6415

L12

LD SPULE
COIL

338.6596

338.6415

L13

LD SPULE
COIL

338.6596

338.6415

L14

LD SPULE
COIL

338.6596

338.6415

L16

LD SCHUTZLEITERDROSSEL
NUR VAR : 52 53

338.6444

L17

LD 0,100H10%,0,02OHM1,400A
CHOKE
DELEVAN DROSSEL1025-94

LD 067.2740

338.6715

N1

B0 UA7805UC + 5V1A0 VREGL
VOLTAGE REGULATOR
FAIRSCHILD UA7805UC

B0 336.4615

338.6715

R11

RL 0,65W 1,00KOHM+-1%TK50
METAL FILM RESISTOR
RESISTA MK4 1K 1% TK50

006.2286

338.6715

R12

RF 0,5 W 50 OHM+-5%
DEPOS.-CARBON RESISTOR
RESISTA SK4/50OHM5%

028.0157

338.6715

R13

RF 0,5 W 50 OHM+-5%
DEPOS.-CARBON RESISTOR
RESISTA SK4/50OHM5%

028.0157

338.6715

R14

RF 0,5 W 50 OHM+-5%
DEPOS.-CARBON RESISTOR
RESISTA SK4/50OHM5%

028.0157

338.6715

338.5219.01 SA BL 3+

ROHDE & SCHWARZ		Äl Datum Date	Schaltteilliste für Parts list for ESH2-Z5 NETZNACHBILDUNG	Sachnummer Stock No.	Blatt Page
		27 0387		338.5219.01 SA	4
Kennzeichen Component No.	Benennung/Beschreibung Designation	Sachnummer Stock No.	enthalten in contained in		
R15	RL 0,35W 274 OHM+-1%TK50 RESISTOR DRALORIC SMA0207/2740HM-F-D	RL 083.0178	338.6715		
R16	RF 0,5 W 50 OHM+-5% DEPOS.-CARBON RESISTOR RESISTA SK4/500HM5%	028.0157	338.6715		
R17	RF 0,5 W 50 OHM+-5% DEPOS.-CARBON RESISTOR RESISTA SK4/500HM5%	028.0157	338.6715		
R18	RF 0,5W 510 OHM+-5% RESISTOR RESISTA SK4/510OHM5%	073.9072	338.6415		
R19	RL 0,35W 2,74KOHM+-1%TK50 RESISTOR DRALORIC SMA0207/2,74K-F-D	RL 083.0926	338.6715		
R20	RL 0,35W 2,74KOHM+-1%TK50 RESISTOR DRALORIC SMA0207/2,74K-F-D	RL 083.0926	338.6715		
R21	RL 0,35W 681 OHM+-1%TK50 RESISTOR DRALORIC SMA0207/681OHM-F-D	RL 083.0490	338.6715		
R22	RL 0,35W 2,74KOHM+-1%TK50 RESISTOR DRALORIC SMA0207/2,74K-F-D	RL 083.0926	338.6715		
R23	RL 0,35W 681 OHM+-1%TK50 RESISTOR DRALORIC SMA0207/681OHM-F-D	RL 083.0490	338.6715		
R24	RL 0,35W 2,74KOHM+-1%TK50 RESISTOR DRALORIC SMA0207/2,74K-F-D	RL 083.0926	338.6715		
R25	RL 0,35W 681 OHM+-1%TK50 RESISTOR DRALORIC SMA0207/681OHM-F-D	RL 083.0490	338.6715		
R26	RL 0,35W 681 OHM+-1%TK50 RESISTOR DRALORIC SMA0207/681OHM-F-D	RL 083.0490	338.6715		
R27	RL 0,35W 2,74KOHM+-1%TK50 RESISTOR DRALORIC SMA0207/2,74K-F-D	RL 083.0926	338.6715		
R28	RL 0,35W 681 OHM+-1%TK50 RESISTOR DRALORIC SMA0207/681OHM-F-D	RL 083.0490	338.6715		
R29	RL 0,35W 3,92KOHM+-1%TK50 RESISTOR RESISTA MK2	RL 083.1039	338.6715		
R30	RL 0,35W 274 OHM+-1%TK50 RESISTOR DRALORIC SMA0207/274OHM-F-D	RL 083.0178	338.6715		
R31	RL 0,35W 12,1KOHM+-1%TK50 RESISTOR DRALORIC SMA0207/12,1K-F-D	RL 083.1351	338.6715		
R32	RL 0,35W 274 OHM+-1%TK50 RESISTOR DRALORIC SMA0207/274OHM-F-D	RL 083.0178	338.6715		
R33	RD 2.4W 6,8KOHM+-3% WIRE-WOUND RESISTOR SAGE 1200S6,8K+3%	RD 087.5200	338.6715		
338.5219.01 SA 8L 4-					



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Parts list for

EST 2-75 NETZNACHBILDUNG

Sachnummer
Stock No.Blatt
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338.5219.01 SA

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Kennzeichen Component No.	Benennung/Beschreibung Designation	Sachnummer Stock No.	enthalten in contained in
R34	RD 2.4W 6,8KOHM+-3% WIRE-WOUND RESISTOR SAGE 1200S6,8K+3%	RD 087.5200	338.6715
R35	RL 0,35W 1KOHM+-1%TK50 RESISTOR DRALORIC SMA0207/1K-F-C	RL 082.2160	338.6715
R36	RL 0,35W 274 OHM+-1%TK50 RESISTOR DRALORIC SMA0207/2740HM-F-D	RL 083.0178	338.6715
BIS/TO R39 R100	RF 1,0W 47 OHM+-5% NUR VAR : 33 53 RESISTOR DRALORIC LCA 0922 470HM+-5%	007.2415	
S1	SD 2EBENEN 3MAL 4 UNTERBR SWITCH SEL SBL17 2 3E25A04U	SD 333.3099	338.6715
S2	SB SCHALTER NETZ 2A POWER SWITCH	SB 020.5489	338.6715
S3	SB DRUCKSCH.2XU KNOPF GR SB DRUCKSCH.2XU KNOB GR SCHADOW 230.9643 R&S-K-BLATT	SB 230.9643	338.6715
S4	SB SCHALT NETZ 2A 0.KNOPF POWER SWITCH PETRICK 285 V (20)1-N 135 E-	SB 020.5495	338.6715
T1	LT RINGKERNTRAFO NUR VAR : 33 53 TRANSFORMER	338.6696	
V1	AK 2N2907A PNP 60V 600MA TRANSISTOR VALVO 2N2907A	AK 010.3583	338.6715
BIS/TO V5 V6	AK 2N2222A NPN 40V 800MA TRANSISTOR VALVO 2N2222A	AK 010.5405	338.6715
V7	AD 1N4531 75V 0,15A UDI DIODE UNITRODE 1N4531	AD 082.6514	338.6715
BIS/TO V17 V18	AG 1N4007 GL1000V 1A0 RECTIFIER AEG-TELEF 1N4007	AG 013.0310	338.6715
V19	AG 1N4007 GL1000V 1A0 RECTIFIER AEG-TELEF 1N4007	AG 013.0310	338.6715
V20	AG B80C700 0A8 BRGL RECTIFIER	AG 092.9345	338.6715
V22	GEN-INSTR B80C800DM AD 1N4531 75V 0,15A UDI DIODE UNITRODE 1N4531	AD 082.6514	338.6715

338.5219.01 SA BL 5+

 ROHDE & SCHWARZ	AI Datum Date 22 0387	Schalteilliste für Parts list for ESH2-Z5 NETZNACHBILDUNG	Sachnummer Stock No. 338.5219.01 SA	Blatt Page 6
Kennzeichen Component No.	Benennung/Beschreibung Designation	Sachnummer Stock No.	enthalten in contained in	
X1	FN EINBAUSTECKER 5POL.ROT 5-PIN CONNECTOR ELEKTRA CGT532/6H NR.56550	338.6638		
X2	FN EINBAUST.M.SPANNUNGSW. CONNECTOR WITH VOLT.SELEC KLAR&BEIL 42R34.3211.200.04	FN 099.2652		
X4	FN EINBAUBUCHSE 5POL. SOCKET 5-POLE ELEKTRA CLS 532/6H NR.90434	338.6621		
X6	ZM DOSE SOCKET	338.6650		
X7	VK RAENDELKL.ISOL.GRAU CLAMP ELMA 024-3010	078.0938		
X8	ISOLIERSCH.ENTFALLEN B.X7 VK RAENDELKL.ISOL.GRAU CLAMP ELMA 024-3010	078.0938		
X9	ISOLIERSCH.ENTFALLEN B.X8 VK RAENDELKL.ISOL.GRAU CLAMP ELMA 024-3010	078.0938		
X10	FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG VOGT 3866A/MS-SN8	FV 530.5457	338.6715	
X12	FP INDIREKT.STECKERL.36P. PIN CONNECTOR BERG 75160-102-36	FP 242.3600	338.6715	
X15	2X5-POLIG/10PINS FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG VOGT 3866A/MS-SN8	FV 530.5457	338.6715	
X19	VK RAENDELKL.ISOL.GRAU NUR VAR : 33 53 CLAMP ELMA 024-3010	078.0938		
X20	ISOLIERSCH.ENTFALLEN B.X19 FP INDIREKT.STECKERL.36P. PIN CONNECTOR BERG 75160-102-36	FP 242.3600	338.6715	
X25	4-POLIG/4 PINS FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG VOGT 3866A/MS-SN8	FV 530.5457	338.6715	
X33	FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG VOGT 3866A/MS-SN8	FV 530.5457	338.6415	
X34	FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG VOGT 3866A/MS-SN8	FV 530.5457	338.6415	
X60	FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG VOGT 3866A/MS-SN8	FV 530.5457	338.6715	
X65	FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG VOGT 3866A/MS-SN8	FV 530.5457	338.6715	
338.5219.01 SA BL 6+				

**ROHDE & SCHWARZ**

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Datum
Date

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Schaltteilliste für

Parts list for

ESK2-Z5 NETZNACHBILDUNG

Sachnummer

Stock No.

338.5219.01

SA

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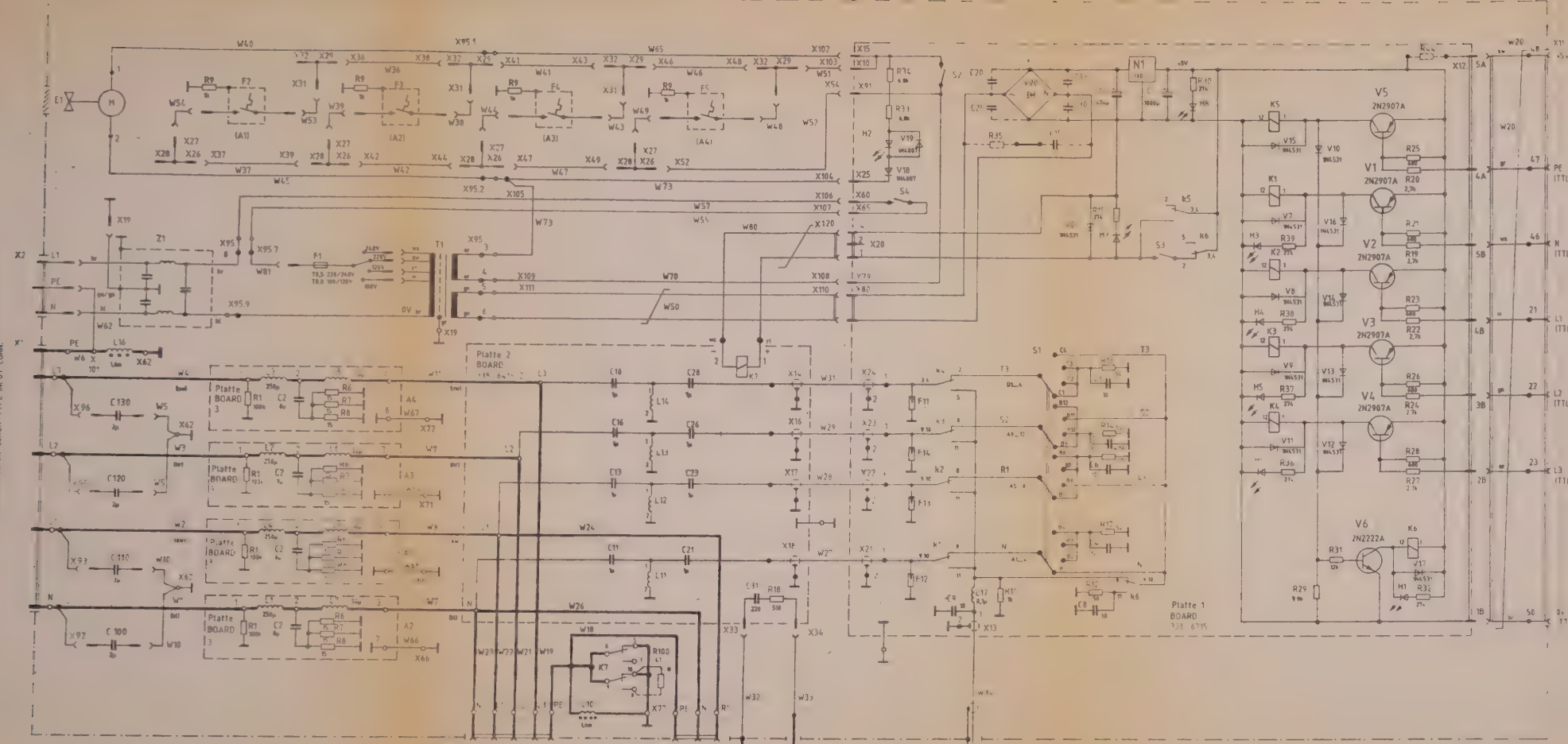
7

Kennzeichen Component No.	Benennung/Beschreibung Designation	Sachnummer Stock No.	enthalten in contained in
X79	FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG VOGT 3866A/MS-SN8	FV 530.5457	338.6715
X80	FP INDIREKT.STECKERL.36P. PIN CONNECTOR BERG 75160-102-36 2-POLIG/2 PINS	FP 242.3600	338.6715
X91	FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG VOGT 3866A/MS-SN8	FV 530.5457	338.6715
X95	VK KLEMMLEISTE 9 POLIG NUR VAR : 33 53	062.7967	
X120	CONNECTING BOARD FP BUCHSENKOERPER 4-POLIG CONNECTOR HOUSING BERG 65039-....	FP 087.8909	338.7540
Z1	LD NETZF.1A 60DP/2MHZ NUR VAR : 33 53 POWER FILTER CORCOM 1VB3	LD 272.5769	
			- ENDE -

338.5219.01 SA BL 7-

RUCKWAND
REAR PANEL

CEKON-STECKER (CEKON-TYPE INPUT CONN.)



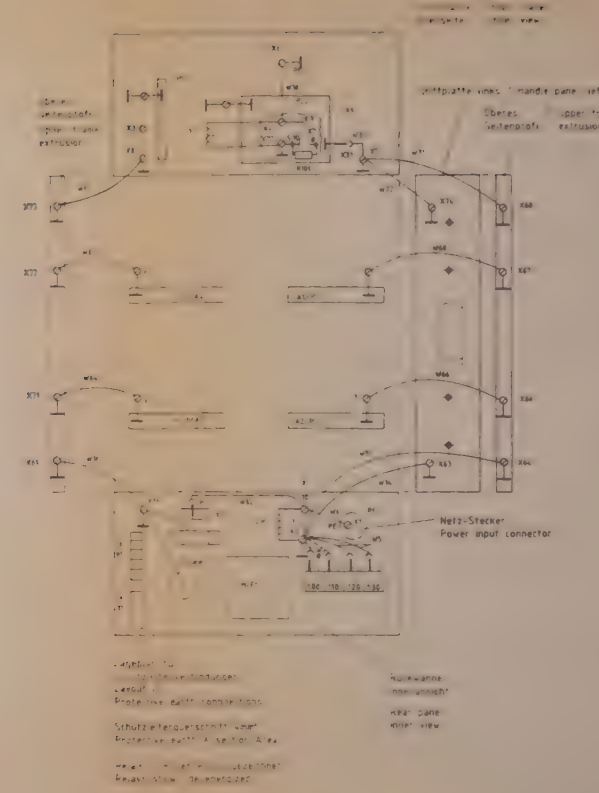
CEKON-DOSE
CEKON-TYPE OUTPUT CONN.

FRONTPLATTE / FRONT PANEL

* Nach Bedarf Widerstand ein- u. auslöten / Solder in or remove resistor as required
siehe Beschreibung / See manual

C12, C16, C17, C19, C22, C24, C27, C29
nicht bestückt / not fitted

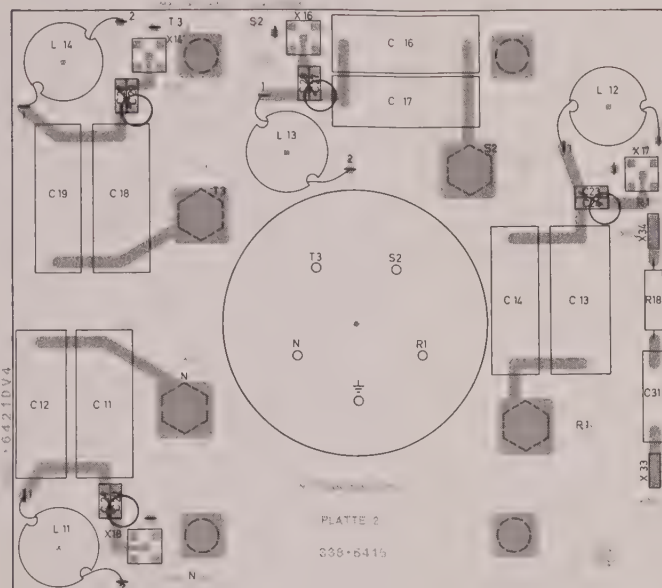
Rückwand
Rear panel



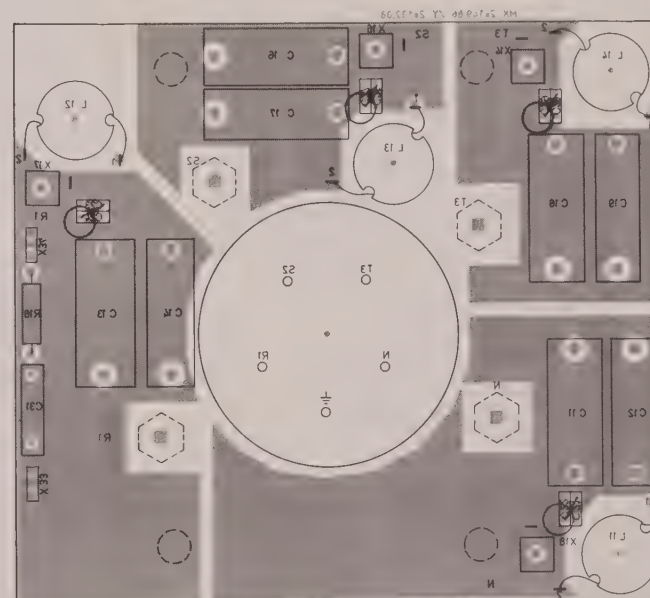
VAR 1: Grundausführung
VAR 2: Grundausführung
VAR 3: Grundausführung mit Schutzleiteraufhebung
VAR 4: Grundausführung mit Schutzleiteraufhebung

VERKLEINERUNG

Ansicht und Leitungsführung Bauteilseite
View of tracks on component side



Ansicht und Leitungsführung Lötseite
View of tracks on solder side



C12, C14, C17, C19, C22, C24, C27, C29 nicht bestückt/not fitted

Versorg. Nr.					
A	33682	09.85	RB	Malle ohne Toleranzangabe	Maßstab 1 : 1
E	33682	00.80	PA		Halbzeug Werkstoff
				10ME	
				28.8.80	SY
				Norm	
				Platte 2	
				Z	
				ROHDE & SCHWARZ	
				Maßstab	
				Zeichn. Nr.	
				338.6415	
				R. Nr. 2	
				B. Nr.	
				Z. Gerat. ESH2-Z5	
				req. 338.5219 V	
				338.5219	

 ROHDE & SCHWARZ	ÄZ Datum Date 02 1084	Schalteilliste für Parts list for ED PLATTE 1 TEILBESTUECKT BOARD 1	Sachnummer Stock No. 338.6515.00 SA	Blatt Page 1
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Kennzeichen Component No.	Benennung/Beschreibung Designation	Sachnummer Stock No.	enthalten in contained in
C3	CC 10PF+-0,25PF3X4NPO CAPACITOR	CC 087.6429	
C4	VALVO 2222 678 09109 CC 10PF+-0,25PF3X4NPO CAPACITOR	CC 087.6429	
C6	VALVO 2222 678 09109 CC 10PF+-0,25PF3X4NPO CAPACITOR	CC 087.6429	
C9	VALVO 2222 678 09109		
C32	CE 100UF-10+100% 6V 9X13 ELECTROLYTIC CAPACITOR SIEMENS B41316-A2107-Z	022.7514	
F11	SU 90V RD 6X4,6 DRAHTANS. VOLTAGE DISCHARGER SIEMENS M11-C90/Q69-X451	335.3421	
BIS/TO F14			
H1	AF HLMP3401 LED GE RD5 LED HEWLETT-P. HLMP-3401	AF 092.8703	
H2	AF HLMP3401 LED GE RD5 LED HEWLETT-P. HLMP-3401	AF 092.8703	
K1	SN GEPOLT 5V 2A+2R RELAY SDS S2-5V GEHAEUSE SCHW.	SN 456.9559	
BIS/TO K4			
K6	SN GEPOLT 5V 2A+2R RELAY SDS S2-5V GEHAEUSE SCHW.	SN 456.9559	
L17	LD 0,10UH10%0,080HM1,400A CHOKE DELEVAN DROSSEL1025-94	LD 067.2740	
R11	RL 0,65W 1,00KOHM+-1%TK50 METAL FILM RESISTOR RESISTA MK4 1K 1% TK50	RL 006.2286	
R12	RF 0,5 W 50 OHM+-5% DEPOS.-CARBON RESISTOR RESISTA SK4/500HM5%	028.0157	
R13	RF 0,5 W 50 OHM+-5% DEPOS.-CARBON RESISTOR RESISTA SK4/500HM5%	028.0157	
R14	RF 0,5 W 50 OHM+-5% DEPOS.-CARBON RESISTOR RESISTA SK4/500HM5%	028.0157	
R16	RF 0,5 W 50 OHM+-5% DEPOS.-CARBON RESISTOR RESISTA SK4/500HM5%	028.0157	
		338.6515.00 SA BL 1+	

 ROHDE&SCHWARZ		ÄZ Datum Date	Schaltteilliste für Parts list for ED PLATTE 1 TEILBESTUECKT BOARD 1	Sachnummer Stock No.	Blatt Page
		02	1084	338.6515.00 SA	2
Kennzeichen Component No.	Benennung/Beschreibung Designation		Sachnummer Stock No.	enthalten in contained in	
R17	RF 0,5 W 50 OHM+-5% DEPOS.-CARBON RESISTOR		028.0157		
R19	RESISTA SK4/500HM5% RL 0,35W 2,74KOHM+-1%TK50 RESISTOR		RL 083.0926		
R21	DRALORIC SMA0207/2,74K-F-D RL 0,35W 681 OHM+-1%TK50 RESISTOR		RL 083.0490		
R22	DRALORIC SMA0207/6810HM-F-D RL 0,35W 2,74KOHM+-1%TK50 RESISTOR		RL 083.0926		
R23	DRALORIC SMA0207/2,74K-F-D RL 0,35W 681 OHM+-1%TK50 RESISTOR		RL 083.0490		
R24	DRALORIC SMA0207/6810HM-F-D RL 0,35W 2,74KOHM+-1%TK50 RESISTOR		RL 083.0926		
R26	DRALORIC SMA0207/2,74K-F-D RL 0,35W 681 OHM+-1%TK50 RESISTOR		RL 083.0490		
R27	DRALORIC SMA0207/6810HM-F-D RL 0,35W 2,74KOHM+-1%TK50 RESISTOR		RL 083.0926		
R28	DRALORIC SMA0207/2,74K-F-D RL 0,35W 681 OHM+-1%TK50 RESISTOR		RL 083.0490		
R29	DRALORIC SMA0207/6810HM-F-D RL 0,35W 3,92KOHM+-1%TK50 RESISTOR		RL 083.1039		
R31	RL 0,35W 12,1KOHM+-1%TK50 RESISTOR		RL 083.1351		
R32	DRALORIC SMA0207/12,1K-F-D RL 0,35W 1KOHM+-1%TK50 RESISTOR		RL 082.2160		
R33	DRALORIC SMA0207/1K-F-C RD 3W 6,8KOHM+-3% WIRE-WOUND RESISTOR		RD 087.5200		
R34	SAGE 1200S6,8K+3% RD 3W 6,8KOHM+-3% WIRE-WOUND RESISTOR		RD 087.5200		
R44	SAGE 1200S6,8K+3% RL 0-WIDERSTAND DIN 0204 0-OHM RESISTOR DRALORIC OMA 0204		RL 069.0000		
S1	SD 2EBENEN 3MAL 4 UNTERBR SWITCH SEL SBL17 2 3E25A04U		SD 333.3099		
V1	AK 2N2907A PNP 60V 600MA TRANSISTOR VALVO 2N2907A		AK 010.3583		
E IS/TC V4 V6	AK 2N2222A NPN 40V 800MA TRANSISTOR VALVO 2N2222A		AK 010.5405		
338.6515.00 SA BL 2+					



ROHDE & SCHWARZ

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Datum
Date

Schaltteilliste für

Parts list for

ED PLATTE 1 TEILBESTUECKT

Sachnummer

Stock No.

Blatt

Page

02

1084

BOARD 1

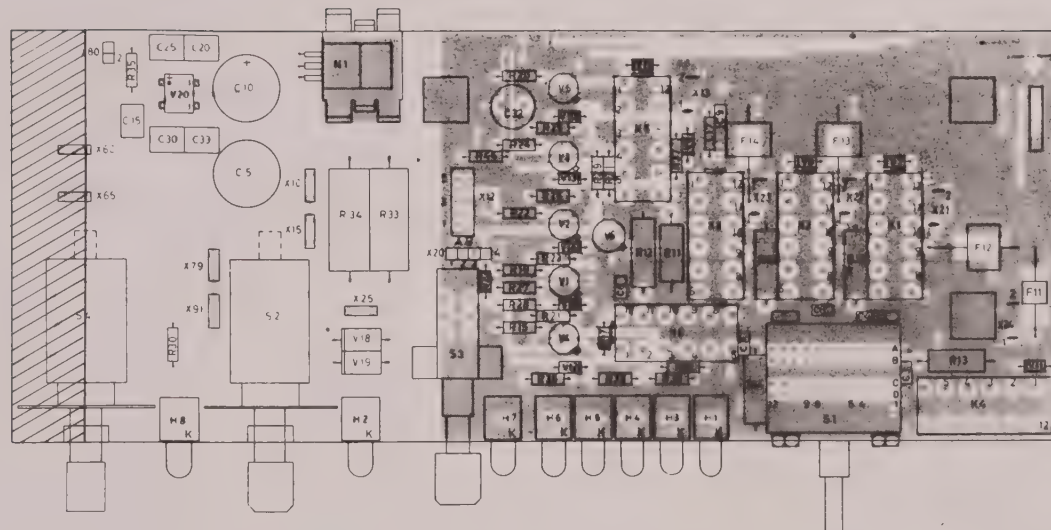
338.6515.00 SA

3

Kennzeichen Component No.	Benennung/Beschreibung Designation	Sachnummer Stock No.	enthalten in contained in
V7	AD 1N4531 75V 0,15A UDI DIODE	AD 082.6514	
V8	UNITRODE 1N4531 AD 1N4531 75V 0,15A UDI DIODE	AD 082.6514	
V9	UNITRODE 1N4531 AD 1N4531 75V 0,15A UDI DIODE	AD 082.6514	
V11	UNITRODE 1N4531 AD 1N4531 75V 0,15A UDI DIODE	AD 082.6514	
	UNITRODE 1N4531		
BIS/TO V14			
V16	AD 1N4531 75V 0,15A UDI DIODE	AD 082.6514	
	UNITRODE 1N4531		
V17	AD 1N4531 75V 0,15A UDI DIODE	AD 082.6514	
	UNITRODE 1N4531		
V18	AG 1N4007 6L1000V 1A0 RECTIFIER	AG 013.0310	
	AEG-TELEF 1N4007		
V19	AG 1N4007 6L1000V 1A0 RECTIFIER	AG 013.0310	
	AEG-TELEF 1N4007		
X10	FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG	FV 530.5457	
	VOGT 3866B/MS-SN8		
X12	FP INDIREKT. STECKERL. 36P. PIN CONNECTOR	FP 242.3600	
	BERG 75160-102-36		
	10-POLIG/10 PINS		
X15	FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG	FV 530.5457	
	VOGT 3866B/MS-SN8		
X25	FV FLACHSTECKER GR.6,3 FLAT-CABLE PLUG	FV 530.5457	
	VOGT 3866B/MS-SN8		

338.6515.00 SA BL 3-

Ansicht und Leitungsführung Bauteilseite
View of tracks on component side



Nicht bestückte Bauteile !
Not fitted !

K5, N1,
C5, C10, C15, C20, C25, C30, C33,
V5, V10, V15, V20, V22,
H3, H4, H5, H6, H7, H8,
S2, S3, S4,
X20, X60, X65, X73, X80, X91,
R15, R20, R25, R30, R35, R36,
R37, R38, R39

A	—	06.84 SY	Max. line width 0.25mm	Min. size 1:1
B	31972	09.84 DR		
C	37966	09.86 NL		
			1KGF 06.84 SY	Platte 1
				Z
			RONDE & SCHWARZ	338. 6515
			ESH 2 - Z5	338 5219 V
				338 5219

 ROHDE & SCHWARZ		ÄZ Datum Date	Schalteilliste für Parts list for	Sachnummer Stock No.	Blatt Page
05		0984	ED PLATTE 3 PLATE 3	338.6673.00 SA	1
Kennzeichen Component No.	Benennung/Beschreibung Designation			Sachnummer Stock No.	enthalten in contained in
C2	CK 8UF+-10%400V35,5X75MKP RIFA PHH481MD780			338.6709	
R1	RF 1,0W 100KOHM+-5% DEPOS.-CARBON RESISTOR DRALORIC LCA 0922 100KOHM+-5%			RF 007.2815	
R6	RF 1,0W 15 OHM +-5% RESISTOR DRALORIC LCA 0922 150HM+-5%			RF 007.2350	
R7	RF 1,0W 15 OHM +-5% RESISTOR DRALORIC LCA 0922 150HM+-5%			RF 007.2350	
R8	RF 1,0W 15 OHM +-5% RESISTOR DRALORIC LCA 0922 150HM+-5%			RF 007.2350	
R9	RF 1,0 W 1 KOHM+-5% DEPOS.-CARBON RESISTOR DRALORIC LCA 0922 1,0KOHM+-5%			RF 007.2573	
X26	FV FLACHSTECKER GR4,8X0,8 PLUG VOGT&CO 3826 MS/0,8 VERZINNT			FV 545.4000	
X27	FV FLACHSTECKER GR4,8X0,8 PLUG VOGT&CO 3826 MS/0,8 VERZINNT			FV 545.4000	
X28	FV FLACHSTECKER GR4,8X0,8 PLUG VOGT&CO 3826 MS/0,8 VERZINNT			FV 545.4000	
X29	FV FLACHSTECKER GR4,8X0,8 PLUG VOGT&CO 3826 MS/0,8 VERZINNT			FV 545.4000	
X31	FV FLACHSTECKER GR4,8X0,8 PLUG VOGT&CO 3826 MS/0,8 VERZINNT			FV 545.4000	
X32	FV FLACHSTECKER GR4,8X0,8 PLUG VOGT&CO 3826 MS/0,8 VERZINNT			FV 545.4000	
338.6673.00 SA					BL 1-

TIME	DATE	NAME	LAST	NR	DATE	NAME
gezeichnet	8	SP	A	26 556	11.80	Gh
bearbeitet		Sy.	B	31972	11.84	Dr
geprüft						
normgepr						

**ROHDE & SCHWARZ**

Platte 3

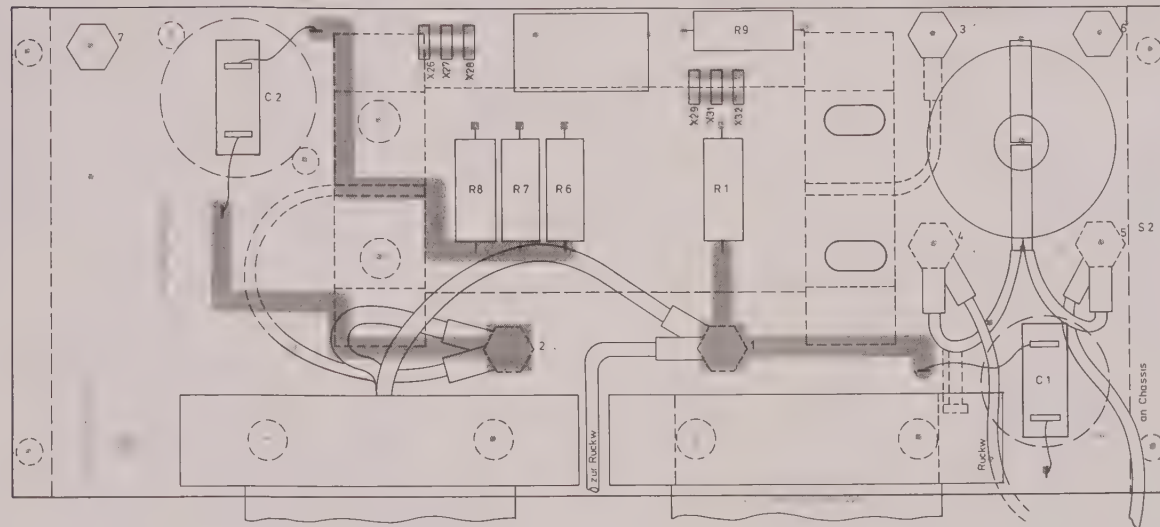
erste Z. 3 38.5219

338.6673 S

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v 1 Bl

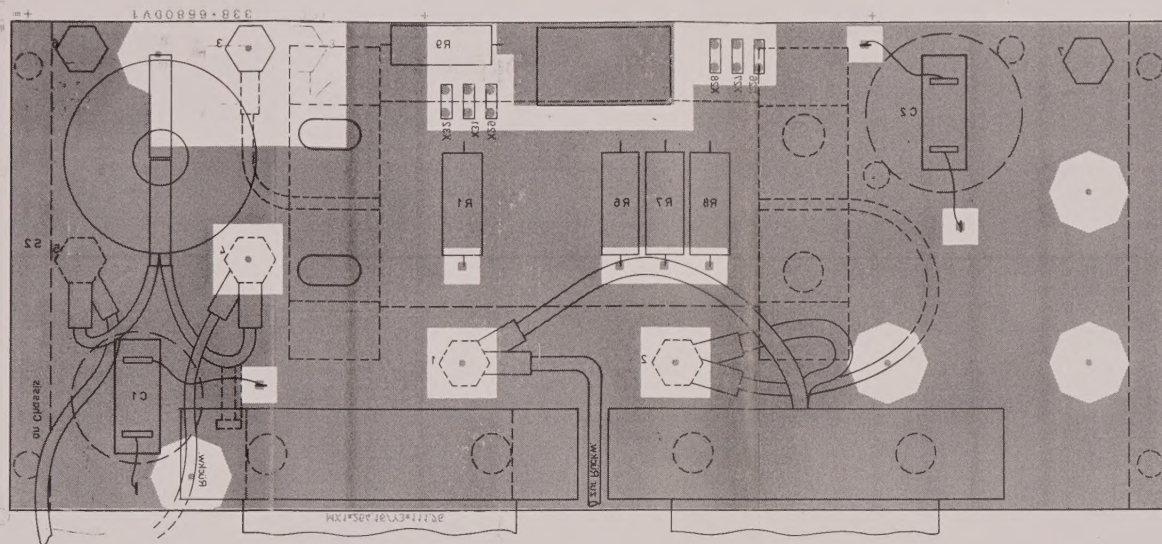
Ansicht und Leitungsführung Bauteilseite
View of tracks on component side



Version Nr.		Maße ohne Toleranzangabe		Maßstab 1 : 1	
				Holtweg Werkstatt	
1GME		SY		Platte 3	
Begr. 1.9.80				Z	
Epr.					
N. 1.9.80					
Rohde & Schwarz München		338.6673		2	
ESH2-Z5		338.5219V		338.5219	

Ansicht und Leitungsführung Lötseite
View of tracks on solder side

Ansicht und Leitungsführung Lötseite
View of tracks on solder side



Versorg.-Nr.		VP-Sachnr.	
		Mallstat 1:1	
		Haltzeug-Werkstoff	
IGME	Tag	Name	Benennung
Bearb.	1.9.80	SY	Platte 3
Gepr.			
Norm			
ROHDE & SCHWARZ MÜNCHEN			Zeichen-Nr. 338.6673
And. Zust.	Änderungs-Mittelung	Tag	Name
zu Gerät ESH2-Z5		ser. 338.5219V	erste Z 338.5219

Z

Blatt-Nr.
3

